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ABSTRACT

The document is the third of a series, to be integrated with a G.E.D. program, containing instructional materials at the basic skills level for the construction cluster. The volume focuses on plumbing and consists of 20 instructional units which require a month of study. The units include: (1) importance of plumbing; (2) pipe and tubing connection; (3) blueprint reading and measuring tools; (4) blueprint reading and power tools; (5) systems design and testing equipment; (6) systems design, testing, and fitting; (7) systems design and materials used; (8) residential sewage systems; (9) cold water distribution systems and residential floor plans; (10) heating systems; (11) boilers and chimneys; (12) heat; (13) hot water heating systems; (14) selection and installation of fire lines; (15) leadwork and flanges; (16) transits; (17) on-the-job work aids; (18) private disposal systems; (19) railing work, repair, and storm information for the teacher: aim, instructional aids, equipment, primary references, introduction and motivation, a presentation of integrated concepts, application, evaluation criteria guidelines, summary, suggested time and sequence listing, and supplemental references and resource materials. A bibliography and resource list are included. (EC)

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Commonwealth of Pennsylvania
Department of Justice
Bureau of Correction

VOCATIONAL EDUCATION PROGRAM OF STUDIES

Elementary, Secondary Education Act

Title I

CONSTRUCTION CLUSTER
VOLUME III

U S DEPARTMENT OF HEALTH,
EDUCATION & WELFARE
NATIONAL INSTITUTE OF
EDUCATION

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January 1, 1971
Pennsylvania Bureau of Correction

Harry A. Snyder
Director of Education

INTRODUCTION

The following information comprises one of seven volumes of instructional materials developed around a cluster of Construction Industries and Occupations. These instructional materials are primarily technical in focus but are written to be used in a cluster concept program as part of an integrated curriculum.

The materials are aimed at preparing students with basic skills necessary to enter a number of occupations in industries within the Construction cluster rather than providing an in-depth development of skill in any one occupation.

Each volume contains approximately one hundred twenty hours of instruction (about one month of study) and consists of twenty instructional units each having one or more specific lessons. Each unit is designed for six hours of instruction (three hours of technical laboratory experiences and three hours of related study in science, mathematics, communications and social studies) but may be varied at the instructor's discretion.

The seven volumes or cluster areas in the series are:

Volume I - Wood Structural Framing
II - Masonry Work
III - Plumbing
IV - Concrete Work
V - Electrical
VI - Air Conditioning and Refrigeration
VII - Heating and Ventilation

Students in the Construction cluster should be introduced to the technical and integrated content through several methods closely related to the industrial structure. Among these are line production and assembly, group projects, experimentation, unit studies and independent study. Team teaching techniques should be employed between the academic specialist and the technical specialist and coordinators.

It is recommended that an orientation program be offered students to familiarize them with the cluster areas available so they may select one they wish to pursue. The cluster instruction is designed to integrate with the regular G. E. D. program so students may receive an employable level of skill and a general academic background simultaneously.

As students select the technical cluster areas they wish to study, they should have the option to move through the G. E. D. content at their own speed using programed instructional materials, instructional television, computer assisted instruction and other individualized learning techniques. Technical and integrated concepts are introduced each day by the specialists involved.

After completion of one or more months of work within one cluster, a student could elect to study within another cluster providing, of course, this transfer is agreeable with the counselors, coordinators and instructors involved.

Lessons have been identified in the units. In most cases, however, there is only one lesson since each unit is limited to one day or six hours of instruction. The units offer the instructor the essential materials, vis-a-vis the aims, instructional aids, topical outline and activities, suggested time sequence, evaluation guidelines, summary and references. The primary and supplemental references are directly related to the topics and are important to the instructors. A selected bibliography is attached at the end of each volume as recommended additional sources of information.

Pagination of the units in this volume has been identified by cluster (C), volume (I, II, etc.), unit (1, 2, etc.) and page (.1, .2, .3, etc.) within each unit.

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INSTRUCTOR'S UNIT PLAN

Unit 1
Lesson 1
Time 6 Hours

CLUSTER: CONSTRUCTION

DIVISION: PLUMBING

SUBJECT: Importance of Plumbing

AIM:

To develop in the student an understanding of:

A. Why man must have waste disposal systems.

B. The development of the waste disposal systems through history.

C. An overview of the tools, devices and requirements he will be expected to master.

D. To develop student's desire to accomplish due to pride in work and personal satisfaction through doing a very necessary job well.

INSTRUCTIONAL AIDS:

Film - The Problem With Water Is People, Washington, D. C.: National Association of Plumbing, Heating, Cooling Contractors, 1016 20th Street N. W. (16 mm).

Hand Tools - Wrenches, cutting tools, threading equipment, heating and welding equipment, thread lubricant.

EQUIPMENT:

Benches with pipe vises.

16 mm projector and screen.

PRIMARY REFERENCES:

1) Investigate local union apprenticeship training materials.

2) Matthias, A. J., Jr. et al., How to Design and Install Plumbing, Chicago: American Technical Society, 1968.

3) Plumbing Apprentice and Journeyman Training, Washington, D. C.: Joint Apprentice Text, Inc., Merkle Press, Inc.

4) Slater, Harry, Plumbing, Related Information 1, Albany, New York: Delmar Publishers, Inc., 1958.

I. INTRODUCTION AND MOTIVATION

A. Introduce and show film: The Problem With Water Is People. Follow with discussion of film. Guide discussion to the history of plumbing. Questions: Without effective treatment plants, what would the state of water now be? Could cities exist without collection and treatment facilities?

II. PRESENTATION OF INTEGRATED CONCEPTS

	RELATED CONCEPTS	
INSTRUCTIONAL TOPICS	***TECHNICAL CONCEPTS***	***SCIENCE***
A. Need for plumbing. 1. Disposition of waste. a. City - private b. Health c. Convenience 2. Transportation. a. Sewer system b. Treatment plant 3. Systems must be designed, installed and repaired.	1. City planning. a. Residences 1) Single 2) Multiple 3) Commercial buildings b. Location of 1) Feeder and trunk systems 2) Treatment plants c. Accessibility of systems for connection and repair	1. Bacteria. a. Description and identification b. Growth and reproduction c. Conditions favorable and unfavorable for growth d. Effect on human health e. Uses of bacteria 1) Production of certain foods 2) Use in disposition of sewage 3) How grown and controlled
B. Hand tools. 1. Overview of: a. Pipe cutting equipment b. Pipe threading equipment c. Devices used to tighten and loosen pipes d. Heating equipment 1) Soldering 2) Lead melting 3) Brazing and welding 2. Each tool will be completely explained when it is to be utilized during the training. 3. Complete explanation of thread cutting equipment.	1. Individual tool use. a. Specialization of equipment b. Multiplicity of use of hand tools that are not extremely specialized c. Required versatility of the individual to become master mechanic	1. Study of bacteriological equipment and procedures. a. Culture growth equipment and techniques b. Prepare bacteria cultures for future study of bacteria control
C. Cutting short sections of black pipe or galvanized pipe and cutting threads using proper tools, lubricants and procedures.	1. Basic tool use introduction. a. Tool choice b. Tool use c. Need for lubricant d. Establish thoughts toward proper nomenclature of supplies, tools and equipment	1. Properties of petroleum: a. Crude b. Refined c. Special application 1) Mixtures 2) Additives such as sulphur (as thread lubricant additive)

TO BE DEVELOPED

MATH	COMMUNICATIONS	SOCIAL STUDIES
1. Simple. a. Addition b. Subtraction c. Multiplication d. Division	1. Trade vocabulary. a. Apprentice, journeyman, master b. Resume of self, prepared for presentation in seeking employment	1. Cultures of the world. a. Ancient cultures and their disposition problems b. Ancient advanced disposition systems 1) Island of Crete 2) Rome 3) Egypt 2. The average man's knowledge of history is limited.
1. Introduce concept of torque. a. Lever arm b. Measurement c. Effect 1) Too little 2) Too much d. Applications in plumbing 1) Use with fitting and threading techniques 2) Excessive force will collapse hollow pipe	1. Basic skills a. Spelling b. Reading assignment in apprentice handbook. (This handbook may vary. It may be assigned by union overseeing or sponsoring the training.) c. Library research to discover the origin of the apprenticeship system	1. Hand tools in different cultures of the world. a. Advanced nations and tools b. Emerging nations and tools plus struggle to advance knowledge of use c. Retarded nations and tools still in very simple development use 2. Mechanization is the present day slave power.
1. Skills practice drill. a. Addition b. Subtraction c. Multiplication d. Division	1. Vocabulary of threads. a. American standard pipe thread 1) Angle 2) Taper 3) Perfect and imperfect	1. Different civilizations use of pipe over the span of time. a. Reeds b. Aqueducts c. Earthen d. Ceramic e. Metal 2. Ancient civilizations existed before Christianity.

III. APPLICATION

A. Have students identify type of materials that pipes had been made of in prior civilizations.

B. Students will demonstrate their understanding of pipe threading equipment by making threads on small lengths of pipe.

C. Students will work as teams checking each others work and naming the parts of the equipment.

IV. EVALUATION CRITERIA GUIDELINE

A. Exploded view of thread cutting equipment, students required to properly name the pieces.

B. Three reasons plumbing is necessary.

C. Name two old civilizations that had disposal systems nearing the modern cities systems.

D. Name things that have been used for pipe in older times and are still used in some places today.

V. SUMMARY

A. As man has become more plentiful and concentrated into civilizations, the need for plumbing has increased. In the future, the need will become even greater for the population is growing and waste disposition problems grow in relation to the population.

B. The threads you have cut represent one of the basic steps you must master on the road to becoming a master plumber.

VI. SUGGESTED TIME AND SEQUENCE LISTING

45 minutes -- Introduce and show film: The Problem With Water Is People

120 minutes -- History of plumbing

60 minutes -- Laboratory experience: Use of thread cutter

115 minutes -- Integrated curriculum concepts

20 minutes -- Summary and evaluation

VII. SUPPLEMENTAL REFERENCES AND RESOURCE MATERIAL

1) B and G Handbook, The, Morton Grove, Ill.: Bell and Gossett Company, 1960.

2) Babbitt, Harold E., Plumbing, New York: McGraw-Hill Book Company, 1960, 3rd Edition.

3) Dibble, Samuel Edward, Plumbers' Handbook, New York: McGraw-Hill Book Company, 1964.

4) Hunt, Dewitt, Shop Tools: Care and Repair, Princeton, N. J.: D. Van Nostrand Company, Inc., 1958.

5) Pamphlets: Accident Prevention Can Be Learned, New York: Metropolitan Life Insurance Company, 1962.
Teacher's Manual: Shop Safety Education, Albany, N. Y.: The University of the State of New York, State Education Department, 1950.

6) Swanson, Carl P., The Cell, New York: Prentice-Hall, Inc., 1964, 2nd Edition.

INSTRUCTOR'S UNIT PLAN

Unit 2
Lesson 1
Time 6 Hours

CLUSTER: CONSTRUCTION

DIVISION: PLUMBING

SUBJECT: Pipe and Tubing Connection (Threading and Soldering)

AIM:

To have the student gain an understanding of:

A. Thread nomenclature:
  1. Manual thread cutting equipment, its nomenclature, adjustment and proper maintenance
  2. The need for cutting lubricants
  3. Threaded fittings

B. Tubing solder joints:
  1. Prestolite tank heating unit
  2. Solder, its composition and flow characteristics
  3. Solder flux, its use in aiding to make a proper solder joint

INSTRUCTIONAL AIDS:

Prestolite tank and regulator.

Solder and flux.

Pipe and fitting.

EQUIPMENT:

Manual thread cutting taps and die sets, thread lubricant, benches, supply of tubing and fittings for solder practice, Prestolite tanks and regulator for student practice, solder and flux.

PRIMARY REFERENCES:

1) Matthias, A. J., Jr. et al., How to Design and Install Plumbing, Chicago: American Technical Society, 1968.

2) Starbuck, Robert M., Sanitary Plumbing, Vol. III, Hartford, Conn.: R. M. Starbuck & Sons, Inc., 1954.

I. INTRODUCTION AND MOTIVATION

A. Have students acquire threaded pipe from last meeting. Discuss the need for nomenclature so each technician will understand his conversation. At end of above section of class, introduce and show big league soldering; discuss need for perfect joint each time.

II. PRESENTATION OF INTEGRATED CONCEPTS

RELATED CONCEPTS

INSTRUCTIONAL TOPICS	TECHNICAL CONCEPTS	SCIENCE
A. Threading of pipe. 1. Origin of American standard pipe and pipe thread.	1. Thread nomenclature. a. Perfect threads b. Imperfect at top thread c. Imperfect at bottom threads d. Taper e. Angle 2. Production of unmarred, cracked or broken threads or leaks will develop.	1. Kinetic energy. 2. Potential energy.
B. Pipe sizing and threads per inch.	1. Tables. a. Selection for proper job requirements b. Pipe size determines threads per inch	1. Water as: a. Kinetic energy b. Potential energy
C. Review of thread cutting equipment nomenclature. 1. Machining of dies. 2. Thread standard length.	1. "S" marks. 2. Lubrication. a. Lard oil b. Sulphur content advantages 3. Chip space. a. Clearance b. Lead angle c. Lip angle 1) For steel pipe 2) For wrought iron, brass and copper d. Numbered position e. Clean before insert f. Armstrong dies, serial number requirements 4. Pipe at end of die is standard length.	1. Friction. a. Contact of objects b. Resistance to movement of: 1) Liquids in pipes 2) Liquids in channels
D. Threaded fittings.	1. Definition of threaded fitting. a. Malleable iron fittings 1) Nipples 2) Fittings 3) Fitting specifications 4) Fitting angles 5) Fitting couplings 6) Fitting allowances b. Drainage fittings 1) Fitting angles 2) Fitting interconnectors	1. Effect on flow characteristics of liquids at: a. Bends b. Interruption due to flow over split surfaces (joints) c. Branch joining larger flow d. Through reduction resistances

TO BE DEVELOPED

MATH	COMMUNICATIONS	SOCIAL STUDIES
1. Inclined plane used to do work. 2. Inclined plane as a thread. 3. Torque and the inclined plane. 4. Demonstrations, experiments and problems concerning inclined plane and screw. 5. Calculation of force required to move various resistances.	1. Read history of Robert Briggs. 2. Begin handbook for class members to contain nomenclature, references, titles of subject matter and tables of pipes, equipment and interchangeability. 3. Necessity for and skills needed for note taking.	1. Sources of natural water potential energy sources. a. How the potential energy could be stored b. How could the potential energy be changed into kinetic energy 2. Water shortages in various regions of the U. S. are causing concern to federal, state and local governments.
1. Circles. a. Areas b. Flow potential through different sized circles	1. Short report on source of each factor in the formula for area of: a. Circles b. Triangles c. Rectangles d. Squares	1. Problems connected with construction of dams in sites selected. 2. Flood Control Act of 1936, a New Deal Conservation Program, established a nationally coordinated policy of flood control.
1. Torque. a. To overcome resistance b. To supply the correct pressure to a given object c. Torque problems	1. Short letter to a friend explaining the torque wrench, its parts, use and why one should learn to use it.	1. Problems connected with transportation of the energy from source of production. 2. The introduction of steam power to replace water power made possible the existence of factories geographically removed from streams and rivers.
1. Triangles. a. Nomenclature of triangles b. Area of triangles c. Pythagorean theory (law) d. Problems	1. Library research to discover: a. Nomenclature of triangles b. Who Pythagoras was, when he lived and what he taught	1. Use of power in the production of tools and equipment needed by the plumber. a. Machines b. Plants c. Transportation 2. The factory system of production became very important by the year 1850.

II. PRESENTATION OF INTEGRATED CONCEPTS

		RELATED CONCEPTS
INSTRUCTIONAL TOPICS	*TECHNICAL CONCEPTS*	*SCIENCE*
E. Brass pipe.	1. Composition. a. Copper and zinc b. Lengths c. Diameters d. Threading dies 1) Lip angle 2) Use of silbraze to prevent weakness; explain silbraze joint 2. Expansion consideration. 3. Fittings.	1. Make a formula that will produce brass. a. Produce several types of brass b. Discuss why each brass is different
F. Copper tubing and fittings.	1. History. 2. Advantages and objection to use: a. Cost b. Expansion c. Desirable characteristics 3. Types. 4. Fittings. 5. Joining methods. a. Solder b. Flaring	1. Surface characteristics of: a. Glass b. Plastics c. Metals 1) Copper 2) Cast iron 3) Galvanized surfaces
G. Prestolite and other solder methods.	1. Tank. 2. Solder composition. 3. Flux, its use and why. 4. Joint characteristics.	1. Laws of pressure. a. Action within the contained b. Compressibility of liquids c. Height of liquid in container producing pressure d. Application of pressure laws to gases e. Phase changes of gases to liquid and reverse
H. Making of the joint.	1. Cutting. 2. Preparation. 3. Producing the joint.	1. Pressure transmission over distances. a. Pressure loss b. How pressure could be restored
I. Practical experience.	1. Production of joints. a. Malleable iron pipe b. Drainage c. Brass pipe d. Copper pipe	1. Controlled flow of pressurized liquid. a. Inertia of liquids b. Shock effect of liquids in pipes during sudden stoppage of flow c. Heating effects

TO BE DEVELOPED

MATH	*COMMUNICATIONS*	*SOCIAL STUDIES*
1. Ratios. a. Simple ratios b. Ratio of expansion	1. Library research to discover what industrial periodicals pertain to their chosen profession.	1. Use by the individual plumber at the job site. a. Cutting tools b. Welding c. Light d. Heat
1. Pressure. a. Meaning of PSI b. How to arrive at total pressure on a surface c. How to compute a pressure when given facts as to placement of container and surface d. Calculation of the effects of energy, volume and pressure changes.	1. Basic communication skills drill. a. Reading in industrial periodicals b. Development of vocabulary list to be included in notebook c. Review of forms for letters, reports and resumes	1. Background study explaining individual jobs of people engaged in the energy production.
1. Practical application. a. Flow potential thru given pipe size b. Pressure available at different levels in a multicity system if cities are located at different levels c. Length of sides of triangles d. Torque problems	1. Basic spelling skills drill.	1. Geology study. a. Strata b. Absorption potential of 1) Stone 2) Slate 3) Clay 4) Soil 5) Sand c. Water table 1) Rain infiltration 2) Depletion by use
		1. Hydro pressure. a. Artesian well b. Pumped well
		1. Strata effect on the growth of population thru control of water availability. 2. The Erie Canal (1825) made possible an all-water route from New York to the interior of the country.

III. APPLICATION

A. Have students produce joints of each type of material listed in lesson.

B. Have students pressure check their fittings.

IV. EVALUATION CRITERIA GUIDELINE

A. Quality of work produced by individual.

B. Students to be required to properly identify nomenclature of threads, dies and other equipment.

C. Have students explain each type of joint they have made up to this point.

V. SUMMARY

A. To be able to properly communicate with fellow workers, one must know the proper name of things and equipment. It is also extremely important that the individual joint be well done to insure an overall successful job. It is important the basic steps be mastered at this time before proceeding.

VI. SUGGESTED TIME AND SEQUENCE LISTING

45 minutes -- Introduction

180 minutes -- Laboratory experience--Application

115 minutes -- Integrated curriculum concepts

20 minutes -- Summary and evaluation

VII. SUPPLEMENTAL REFERENCES AND RESOURCE MATERIAL

1) Babbitt, Harold E., Plumbing, New York: McGraw-Hill Book Company, 1960, 3rd Edition.

2) Blendermann, Louis, Design of Plumbing and Drainage Systems, New York: Industrial Press, Inc., 1963, 2nd Edition.

3) Eisinger, L. (Ed.), Handyman's Plumbing and Heating Guide, New York: Arco Publishing Company, Inc., 1955.

INSTRUCTOR'S UNIT PLAN

Unit 3
Lesson 1
Time 6 Hours

CLUSTER: CONSTRUCTION

DIVISION: PLUMBING

SUBJECT: Blueprint Reading and Measuring Tools

AIM:

This unit is to have the student develop an understanding of:

A. Architectural drafting:
    1. Drafting procedures
    2. Pictorial representation location
    3. Symbol representation
    4. Measuring tools
        a. Length
        b. Diameter
        c. Thread
    5. Caulking tools

B. The use of the drafting equipment as well as caulking tools.

INSTRUCTIONAL AIDS:

Plumbing blueprints (working drawings from jobs that have been completed).

Complete architectural drawings of commercial buildings and single homes.

EQUIPMENT:

Drafting tools, paper, pencils and pens, ink; drafting boards and paper holders.

Pipe, oakum and caulking tools.

Joint lead and heating equipment.

PRIMARY REFERENCES:

1) French, Thomas E. and Vierck, Charles J., Manual of Engineering Drawing for Students and Draftsmen, New York: McGraw-Hill Book Company, 1963.

2) Giesecke, Frederick E. et al., Technical Drawing, New York: Macmillan Company, 1958, 4th Edition.

3) Spence, William P., Architecture, New York: McKnight & McKnight Publishing Company, 1967.

4) Starbuck, Robert M., Sanitary Plumbing, Vol. III, Hartford, Conn.: R. M. Starbuck & Sons, Inc., 1954.

I. INTRODUCTION AND MOTIVATION

A. Display the drawings and equipment. Explain the important part this lesson will play in their future employment.

B. At the end of the drawing section, demonstrate how to properly make and caulk a joint.

II. PRESENTATION OF INTEGRATED CONCEPTS

		RELATED CONCEPTS
INSTRUCTIONAL TOPICS	*TECHNICAL CONCEPTS*	*SCIENCE*
A. Overview of architectural drafting.	1. Location of views upon drawings. a. In relation to a box b. Line weights c. Symbols	1. Study of bacteria. a. Examine culture made in prior lesson b. Stain and identify types c. Growth patterns d. Their use in sewage disposal e. Demonstrate bacteria killing techniques
B. Tools of drafting.	1. Machine. a. Simple b. Complex 2. Hand. a. Drafting board b. Tools 1) "T" square 2) Angles 3) Other tools	1. Have each student make a culture.
C. Practice in presentation location.	1. Views. 2. Simple projection. 3. Proper live weights. 4. Symbols of the industry as represented on drawings.	1. Vacuum. a. Description and demonstration b. Effect in plumbing system
D. Measuring tools.	1. Length. 2. Diameter. 3. Thread.	1. Have students develop full and partial vacuums and determine the effect upon liquid movement. a. Parial vacuum demonstrations 1) Collapse of hot, capped can by sudden cooling 2) Demonstrate pressure differences produced by pumping action 3) Use of drinking straws, suction bulbs and tubes 4) Problems encountered in emptying one-holed containers
E. Caulking.	1. Caulking tools. 2. Lead--its formulation. 3. Oakum--its formulation.	

TO BE DEVELOPED

MATH	COMMUNICATIONS	SOCIAL STUDIES
1. Measurements. a. English by foot, inch and fractions b. Metric 1) This is for understanding of architectural measurement	1. Basic communication skills.	1. Sources of metal ore for manufacture of metal pipes and tubes.
1. Angles. a. Circle division b. Quadrant c. Addition and subtraction d. How to produce using standard drafting triangles	1. Develop concept of need for organization and planning. 2. Students to develop lesson for presentation to class. To describe and instruct in proper method of making a solder, sweat joint.	1. Transportation of ore to smelters.
1. Using standard plumbing fittings have students develop angles after having been assigned the angle problem to be solved with drafting triangles.	1. Industry vocabulary to be added to list in notebook.	1. The smeltering process. The discovery that coke (1750) rather than charcoal could be used in the smelting process reduced the cost factor significantly.
1. Develop chart comparing inches to millimeter measurements. 2. Student activities involving measurement. a. Student measurement of I.D. and O.D. of pipe b. Measuring and cutting of pipe to length	1. Develop letter to be distributed explaining requirements to become apprentice plumber.	

II. PRESENTATION OF INTEGRATED CONCEPTS

INSTRUCTIONAL TOPICS	TECHNICAL CONCEPTS	RELATED CONCEPTS SCIENCE
F. Caulking tools.	1. Display and discussion of caulking tools. 2. Demonstration of caulking while explaining tools and their proper use.	
G. Practical application.	1. Practical application. a. Students make a complete joint b. Students disassemble the joint	

TO BE DEVELOPED

MATH	COMMUNICATIONS	SOCIAL STUDIES

III. APPLICATION

A. Provide for in the lesson plan:
   1. Practice in drawing
   2. Practice in caulking joints

IV. EVALUATION CRITERIA GUIDELINE

A. Have students draw a graphic representation of a simple object. Have them be very careful of proper line weights.

B. Students are to draw symbols used to represent plumbing units.

C. Students are to caulk a pipe joint using the correct materials, tools and procedures.

V. SUMMARY

A. The ability to read blueprints and architects' drawings will be required of all plumbers. The only way to develop this skill is through practice. The best practice is to make drawings so you will understand the problems and their solutions.

B. The making of a joint that is correct is important for many of them are hidden. It would require much labor to correct a faulty joint so the proper production of a joint can save that labor.

VI. SUGGESTED TIME AND SEQUENCE LISTING

160 minutes -- Laboratory experience--drafting

85 minutes -- Laboratory experience--joint caulking

85 minutes -- Integrated curriculum concepts

30 minutes -- Summary and evaluation

VII. SUPPLEMENTAL REFERENCES AND RESOURCE MATERIAL

1) Bellis, Herbert F. and Schmidt, W. A., Blueprint Reading for Construction Trades, New York: McGraw-Hill Book Company, 1968.

2) Kenney, Joseph E., Blueprint Reading for the Building Trades, New York: McGraw-Hill Book Company, 1955, 2nd Edition.

INSTRUCTOR'S UNIT PLAN

Unit 4
Lesson 1
Time 6 Hours

CLUSTER: CONSTRUCTION

DIVISION: PLUMBING

SUBJECT: Blueprint Reading and Power Tools

AIM:

To have the student become able to:

A. Identify the basic steps in the construction of blueprints.

B. Identify equipment location within a structure.

C. Properly use power pipe threading equipment.

D. Identify and utilize the flexible cleaning tool (snake) and closet auger.

INSTRUCTIONAL AIDS:

Working blueprints.

Scales (for showing pipe weights).

Film - Cutting and Threading Pipe On a Power Machine, Washington, D. C.: Norwood Films, 926 New Jersey Avenue, N. W. (16 mm, 17 minutes, rent-purchase).

Film - Care and Use of Hand Tools, Part 3, Hacksaws, Washington, D. C.: Norwood Films, 926 New Jersey Avenue, N. W. (16 mm, 5 minutes).

EQUIPMENT:

Hacksaws and tubing cutters, power threading machines, assorted sizes of pipe, tools and benches, and required lubricants.

PRIMARY REFERENCES:

1) Matthias, A. J., Jr. et al., How to Design and Install Plumbing, Chicago: American Technical Society, 1968.

2) Oravetz, Jules, Plumbers and Pipe Fitters Library, Indianapolis: Theodore Audel, 1967.

3) Slater, Harry, Plumbing, Related Information 1, Albany, New York: Delmar Publishers, Inc., 1958.

4) Starbuck, Robert M., Sanitary Plumbing, Vol. III, Hartford, Conn.: R. M. Starbuck & Sons, Inc., 1954.

I. INTRODUCTION AND MOTIVATION

A. First 90-minute period: The prior lesson on blueprint reading and architectural drafting will be discussed combined with the steps that will be accomplished in this lesson concerning drafting.

B. Second 90-minute period: Film on hacksaws will be introduced, shown and discussed. Film Cutting and Threading Pipe on a Power Machine will be introduced, shown, and discussed.

C. Demonstration of thread cutting on the power machine after cutting pipe with hacksaw, then a pipe cutter.

II. PRESENTATION OF INTEGRATED CONCEPTS

INSTRUCTIONAL TOPICS	TECHNICAL CONCEPTS	RELATED CONCEPTS SCIENCE
A. Architectural drafting.	1. Identification. a. Special wall widths for plumbing b. Roughing in plumbing 2. Supports location. 3. Vent systems. 4. Drains.	1. Examination and study of bacteria using culture each student had prepared.
B. Multi-story prints.	1. Installation alignment. 2. System considerations. a. Expansion b. Weight	1. Air movement in confined spaces. 2. Vacuums. 3. Partial vacuums.
C. Drawing.	1. Three views of exterior of house. 2. Special attention: a. Vent stack b. Sewage connection line c. Proper symbols	1. Scientific weight and measurement systems.
D. Power tools.	1. Pipe cutters. 2. Power threader. 3. Clean outs (snakes) (closet-auger).	1. Molecular structure of metals and woods. 2. Requirements for separation by cutting of each. a. Character of material as a factor b. Relative hardness of cutting instrument
E. Practical application.	1. Use of: a. Pipe cutters b. Power threaders c. Clean outs (snakes) d. Closet augers 2. Complete an assigned partial system.	

TO BE DEVELOPED

MATH	COMMUNICATIONS	SOCIAL STUDIES
1. Continue study of measuring systems. a. English scales 1) Whole units 2) Fractions b. Metric system 1) Whole units 2) Fractions c. Angles 1) How to measure 2) How to construct	1. Basic language skill drill.	1. Study of mankind's dwellings from ancient to modern. 2. Man adapts to his environment.
1. Pressure. a. Square area measurement b. Volume measurement c. Relate changes in pressure and volume using Boyle's Law	1. Vocabulary of the industry. a. Blueprint reading drafting b. Equipment	1. Study of historical structures. a. Reason for design b. Methods c. What would individual do to equip structures with modern plumbing
1. Basic introduction to strength of materials. a. Load bearing ability of materials b. Measure the tensile strength of various materials	1. Reading of want ads and discussion concerning what type of person is being asked for. 2. Construction of want ads stating requirements of job and necessary experience of individual applying. 3. Practice in answering want ads. a. In writing b. Over the phone	1. Art. a. Why people draw b. Means of historical research c. Use to the individual 2. Reasons for art a. Formal (order) b. Commemorative (memorable)
1. Basic mathematical skills.		1. Tools of mankind. a. Ancient to present b. Social impact

III. APPLICATION

A. Each student will be required to demonstrate the proper use of the:

1. Hacksaw
2. Pipe cutter
3. Power threading machine

B. Each student should be required to complete a simple plan drawing using the proper symbols for the desired units.

IV. EVALUATION CRITERIA GUIDELINE

A. The three views normally shown in drawings are: __a__, __b__, and __c__.

B. What are the symbols for:

1. Gate valve
2. Vent stack
3. "S" drain trap

C. Which direction are the teeth pointing when a blade is installed in a hacksaw frame?

D. What special consideration does an architect give to walls containing plumbing?

E. Instructor will evaluate each student's performance during the application step of the lesson and weigh this with the above questions.

V. SUMMARY

A. From this lesson, you gained an insight into the problems of keeping everything in alinement. If one drawing is incorrect, many problems would be introduced.

B. You have also discovered that the plumbing system has a good deal of weight and that also must be provided for.

C. Power tools can help a person; however, they can also destroy a great deal of material. So, if you have any spare time, practice with them.

D. Working to specifications is difficult but the only method of learning to do it is to do it over and over, so don't despair and good luck.

VI. SUGGESTED TIME AND SEQUENCE LISTING

90 minutes -- Discuss and work on drawing concepts

45 minutes -- Introduce and show films followed by discussions

90 minutes -- Laboratory experience--cutting and threading pipes

115 minutes -- Integrated curriculum concepts

20 minutes -- Summary and evaluation

VII. SUPPLEMENTAL REFERENCES AND RESOURCE MATERIAL

1) Babbitt, Harold E., Plumbing, New York: McGraw-Hill Book Company, 1960, 3rd Edition.

2) Dibble, Samuel Edward, Elements of Plumbing, New York: McGraw-Hill Book Company, no date.

3) Liebers, Arthur, Plumber, New York: Arco Publishing Company, 1947, 1957, 1960.

INSTRUCTOR'S UNIT PLAN

Unit 5
Lesson 1
Time 6 Hours

CLUSTER: CONSTRUCTION

DIVISION: PLUMBING

SUBJECT: Systems Design and Testing Equipment

AIM:

To have the student gain a knowledge of the method in which a system is designed and depicted in commercial blueprints.

To have the student gain the ability to separate the systems and determine their numbers and uses.

To have the student gain the ability to determine the proper test to use to verify a system and the equipment required to perform those tests.

To have the student gain a working ability of the proper methods of making bends in pipe and how to work to fitting allowances including bends.

INSTRUCTIONAL AIDS:

Pipe bending equipment.

Commercial blueprints.

Film - Making a Hot Bend, Washington, D. C.: Norwood Films, 926 New Jersey Avenue N. W. (16 mm, 19 minutes, Contact source for cost).

Film - Circulation of Water in Hot Water Tanks, Washington, D. C.: The National Association of Plumbing Contractors, 1016 20th Street, N. W.

Filmstrip - Making a Hot Bend, Washington, D. C.: Norwood Films, 926 New Jersey Avenue N. W. (44 frame).

EQUIPMENT:

Pipe bending equipment, assorted lengths of pipe, assorted fittings to fit the above pipe, pipe threading equipment, pipe cutting equipment, and projectors and screens as required for chosen audio-visual aids.

Premade specific measurement pipes for students to manufacture bends and fittings and straight pipe plus fittings to fit to.

PRIMARY REFERENCES:

1) Matthias, A. J., Jr. et al., How to Design and Install Plumbing, Chicago: American Technical Society, 1968.

2) Oravetz, Jules, Plumbers and Pipe Fitters Library, Indianapolis: Theodore Audel, 1967.

3) Slater, Harry, Plumbing, Related Information 1, Albany, New York: Delmar Publishers, Inc., 1958.

4) Starbuck, Robert M., Sanitary Plumbing, Vol. III, Hartford, Conn.: R. M. Starbuck & Sons, Inc., 1954.

I. INTRODUCTION AND MOTIVATION

A. Discuss past lessons covering drafting and lead into the plot plan and reading of all possible information from Instructor-obtained blueprints of plot plan, elevations, piping and venting for the home.

B. Introduce and show film: Circulation of Water in Hot Water Tanks. Discuss film as it applies to all hot water systems. Use the film as a basis for introduction of the testing portion of the lesson.

C. Explain bending methods and equipment used to make bends. Reinforce by showing film or filmstrip as selected by the instructor.

D. Show necessary good workmanship because of rigidity of pipe and the flexing of them due to heating and cooling.

II. PRESENTATION OF INTEGRATED CONCEPTS

RELATED CONCEPTS

INSTRUCTIONAL TOPICS	*TECHNICAL CONCEPTS*	*SCIENCE*
A. Systems design.	1. Commercial blueprint interpretation. a. Plot plan b. Over-all view of the building c. Elevations and the plumbing installation d. House drain e. Waste and vent piping f. Water piping 1) Hot 2) Cold g. Gas piping h. Sewage disposal system	1. Plant growth. a. Part of plant life carried on by: 1) Leaf 2) Trunk and limb 3) Root system b. Strength of root system to invade rock and metals such as pipe c. Plant growth drawn to source of liquids in pipes d. Demonstration of water seeking ability of germinating seeds and growing plants
B. Hot water system. 1. Household use.	1. Hot water supply. a. Source b. Piping c. Considerations different than cold water supply 1) Circulation 2) Control 3) Storage	1. Liquids: a. Result of heating 1) Expansion 2) Rise of warmer liquid 3) Circulation due to heat 4) Change in liquid density produced by heating.
C. Hot water system. 1. Household heating.	1. Hot water supply. a. Storage b. Heaters c. Circulation d. Control e. Distribution	1. Heat pattern in metal and water due to conduction--convection--radiation. a. Demonstrate conduction by heating a metal rod b. Use a smoke box to demonstrate convection c. Demonstrate radiation with sun lamp
D. System testing.	1. Testing. a. Hydrostatic b. Smoke and peppermint c. Air and gas d. Water weight	1. How vacuum or pressure can be used to detect flow.
E. Equipment.	1. Equipment needed for testing. a. Air compressor b. Gauge c. Relief valve d. Practical experience on a small shop demonstration system	1. Methods for compressing air. a. How air can be used to make gauges operate b. What occurs when a liquid works against a piston and spring in a confined area

TO BE DEVELOPED

MATH	*COMMUNICATIONS*	*SOCIAL STUDIES*
1. Practical method for computing height. a. Triangulation b. Know height plus estimate with other known height c. Practice with students making sight angle measurements d. Review of similar triangles e. Review of simple ratios	1. Investigate the procedures of a title search. a. What is it b. Who does it c. Purpose it serves 2. Oral reports on the findings.	1. Study of local area effect upon possible systems installation. 2. Most sanitation laws prohibit plumbing connections that make pollution possible.
1. Computation of weights of columns of liquid. a. When ice b. When liquid c. At a chosen temperature	1. Review of organization and planning skills. 2. Pages for booklet for the layman describing: a. Power threading equipment b. Problems connected with designing a home c. Why a plot plan and elevations are needed prior to a house being plumbed	1. Culture and sanitary habits of nomad types of peoples. a. Personal hygiene b. Human waste disposal 2. Roman aqueducts and sewers.
1. Given a heat loss rate, how high would water rise in a given system? a. How to compute b. Introduction of the British Thermal Unit	1. Letter to source requesting use of film for showing during classroom study. 2. Letter to a union leader requesting a speaker on a specific topic.	1. Life length of people with less modern systems than ours vs. our life span. a. Differences b. Causes c. Conclusions
1. Pressure at given points in a column of water at a specific temperature.	1. Information sheet for students describing a vacuum and what pressure is. 2. Independent reading in science fiction area.	1. City growth rate effect upon sanitary system as depicted by older cities in Europe.
1. Computation of volume of air output of a given compressor, at a given pressure.	1.. Discussion, research and written conclusion as to the common practice of air being referred to as a liquid.	1. City growth rate effect upon sanitary system as depicted by older cities in China and Japan.

		RELATED CONCEPTS
INSTRUCTIONAL TOPICS	TECHNICAL CONCEPTS	SCIENCE
F. Fitting allowances.	1. Practical application to learn fitting allowances. a. Bending pipe 1) Bending tools 2) Bending iron pipe 3) Bending copper pipe 4) Measurements. b. Fitting allowances 1) On-the-job measurements 2) Manufacturers' catalogs c. Students produce specific lengths as required by assigned (hypothetical) job	

TO BE DEVELOPED

MATH	*COMMUNICATIONS*	*SOCIAL STUDIES*
1. Circular measurement resultant from straight line measurement.		

III. APPLICATION

A. Provided in the body of the lesson.

IV. EVALUATION CRITERIA GUIDELINE

A. The use of the plot plan is to insure _______.

B. Elevations of the building guide the plumber in _______.

C. Which system can operate due to heat circulation or be operated by pump?

D. What are three of the four methods for testing plumbing systems?

E. What should always be put on a system being tested to prevent accidental overloading?

F. Fitting allowances can be found in books supplied by _______.

G. Instructor evaluation of the fit of the student-produced work when tested against the shop master jigs.

V. SUMMARY

A. The ability to read blueprints is important and comes fro knowing what the designer had in mind. This is represented in symbols and is why so much time has been spent with this type of study.

B. Knowledge of how the different systems operate will be especially helpful when making decisions by oneself on the job.

C. Production of safe quality work can come only after understanding has been obtained by doing the work; this is why such a close check is kept upon your shop work.

VI. SUGGESTED TIME AND SEQUENCE LISTING

10 minutes -- Introduction of blueprint interpretation by covering prior lessons

80 minutes -- Meanings to be obtained from commercial blueprints. Identification of systems from blueprint symbol identification. Plot plan use and other data

45 minutes -- Circulation of Water in Hot Water Tanks followed by discussion covering lesson.

90 minutes -- Demonstration of hot and cold bends and the equipment used to make them. Laboratory experience for the students

115 minutes -- Integrated curriculum concepts

20 minutes -- Summary and evaluation

VII. SUPPLEMENTAL REFERENCES AND RESOURCE MATERIAL

1) Babbitt, Harold E., Plumbing, New York: McGraw-Hill Book Company, 1960, 3rd Edition.

2) Dibble, Samuel Edward, Elements of Plumbing, New York: McGraw-Hill Book Company, no date.

3) Graham, Frank and Emery, T. J., Plumbers and Steam Fitters Guides, Indianapolis: Theodore Audel, no date.

INSTRUCTOR'S UNIT PLAN

Unit 6
Lesson 1
Time 6 Hours

CLUSTER: CONSTRUCTION

DIVISION: PLUMBING

SUBJECT: Systems Design, Testing and Fitting

AIM:

To have the student become aware:

A. Of the many units available for the system designer.

B. That many different units can be utilized to accomplish the several systems tests.

C. They must practice to accomplish accurate and complete work in a short period of time.

INSTRUCTIONAL AIDS:

Blueprints: plot plans and elevations.

A large assortment of types of valves, pipes, traps, fixtures (or models).

A large assortment of types of hangers (or models that have been constructed).

As many as possible of the plugs used in testing and the equipment that is used with them.

EQUIPMENT:

In this lesson, the equipment needed is the same that is listed under Instructional Aids.

PRIMARY REFERENCES:

1) Matthias, A. J., Jr. et al., How to Design and Install Plumbing, Chicago: American Technical Society, 1968.

2) Oravetz, Jules, Plumbers and Pipe Fitters Library, Indianapolis: Theodore Audel, 1967.

3) Slater, Harry, Plumbing, Related Information 1, Albany, New York: Delmar Publishers, Inc., 1958.

4) Starbuck, Robert M., Sanitary Plumbing, Vol. III, Hartford, Conn.: R. M. Starbuck & Sons, Inc., 1954.

I. INTRODUCTION AND MOTIVATION

A. Now that the knowledge of what the designer uses to put his ideas on paper needs to be reversed, it now becomes necessary for you as a plumber to be able to produce a fairly accurate estimate from the drawings used to depict plot and building.

B. The function of the system and its cost must also be taken into consideration. It is therefore necessary for you to have a very wide background in the types of materials and units that are available. These must be committed to memory for the better the knowledge of available equipment, the quicker and better the estimate.

C. The second part of the day will be spent on practical application of your knowledge. While working with the tools, materials and problems, see how many different methods and materials can be used to accomplish the same job.

II. PRESENTATION OF INTEGRATED CONCEPTS

		RELATED CONCEPTS
INSTRUCTIONAL TOPICS	TECHNICAL CONCEPTS	SCIENCE
A. Systems design.	1. Estimates. a. Use of blueprint 1) To determine system requirements 2) Determine reasonable estimate of materials required for cost analysis 3) Determine most suitable type of equipment to utilize b. Variety of items that can be utilized to accomplish each job 1) Valves 2) Pipes a) Metal b) Nonmetallic 3) Traps 4) Fixtures c. Line grade 1) Use of plot plan and elevations to determine trench depth and slope 2) Soil line bracing requirements 3) Pipe, tubing and fixture bracing requirements within the structure	1. Study of scientific approaches to problem solving. a. Discuss the variety of problem solving approaches b. Emphasize the value of mathematical exactness c. Develop student observational skills using shoe boxes which contents he must identify by feel or by shaking the box
B. System supports.	1. Types of supports. a. Pier b. Hangers 1) Concrete inserts 2) Beam clamp 3) Lag screws 4) Reznor Hook 5) Pipe strap 6) Perforated strap iron 7) Clevis hanger 8) F & M Hanger 9) Coil hanger 10) Split ring 11) Special on-the-job type	1. Solar system as a source of heat. a. Sun concentrated rays produce heat b. Black interior box with glass cover having tubes passing through sealed openings, exposed to sunlight. Experiment with smoking punk and record result.
C. Test equipment.	1. Job test requirements. a. Type of system being tested as a determining factor b. Height or size of system as a determining factor c. Plugs d. Selection of test	1. Relative humidity. a. Moisture content of air 1) How determined 2) Effect upon any liquid about as the temperature changes b. How controlled c. Humidity effect upon various materials 1) Wood 2) Fabric d. Calculation of relative humidity using wet bulb and dry bulb thermometer

TO BE DEVELOPED

MATH	COMMUNICATIONS	SOCIAL STUDIES
1. Triangles. a. As formed by grade of soil line and surface b. As basis for use in solving pipe lengths for estimates c. Computation of weight fulcrum arms for supports	1. Basic skill drills.	1. Choose a city to design a sewage disposal system for. a. Population b. Geography of site c. Available routes
1. Torque producing effects of weight. a. Weight division of supports b. Effects of location of hangers upon length of weight c. Pendulum effect of weight due to expansion and contraction	1. Page for booklet. a. Explain to layman proper procedure and steps for cutting pipe for threading b. Explain to layman proper procedures for cutting threads using a hand die set c. Explain to layman proper procedure for cutting threads using a power die set 2. Role playing experiences utilizing above information for development of oral skills.	1. Research considering possible growth patterns. a. Industry b. Population c. Recreation
1. Review and continue study of pressure on area and resultant total pressures. a. Small area of ball as in a ball check valve b. Small area of flapper as in flapper check valve c. Similar problems	1. Oral reports covering reasons for use of each of the test methods used in the testing of plumbing systems.	1. Establish immediate needs estimate as well as growth pattern needed to effectively grow with city estimates. a. Type of plant necessary to reduce wastes to allowable levels b. Should and could the product of the treatment plant be recycled

II. PRESENTATION OF INTEGRATED CONCEPTS

RELATED CONCEPTS

INSTRUCTIONAL TOPICS	TECHNICAL CONCEPTS	SCIENCE
D. Test utilization.	1. Practical application. a. Problem presentation b. Student selection of test c. Conduction of test by students d. Conclusions drawn as to suitability of test selected and proper application of test	
E. Fitting allowance.	1. Practical application. a. Test adapters for above systems tests required of students. Adapters must be so designed to replace section of system in shop mock-up b. Required to replace 1) In-line section 2) Section containing a union, T and valve 3) Section connecting union and connector around a 90° turn	

TO BE DEVELOPED

MATH	COMMUNICATIONS	SOCIAL STUDIES
1. Liquid resistance. a. Pressure that can be resisted by a given body of liquid (as in a fixture trap) b. Liquid weight 1) In column 2) In movement a) Potential energy b) Kinetic energy c. Liquid acting as a compressor when moving in a confined space 1) When air can escape 2) When air cannot escape	1. Pick one test plug to explain. Tell why it was chosen, what it is used for and the proper method of installing and removing.	1. Research and obtain government specifications for allowable plant discharge. a. Are they realistic b. Can modern technology produce the requested result c. What are some determining factors that force selection of certain plants d. Cost study of plant that had been selected
1. Measurement practice. a. Whole numbers b. Fractions c. Locating center lines of circles using bisected 90° angle	1. Construct a letter to a plumbing concern describing an (assigned) problem and requesting the concern submit an estimate.	

III. APPLICATION

A. Provided for within the body of the lesson. (It is suggested to the instructor that he develop progressive job sheets to control the progress as well as indicate progress as an evaluation tool.)

IV. EVALUATION CRITERIA GUIDELINE

A. Student should produce an estimate of materials from a print that has been given him. The print should be from a completed job so that actual material requirements are known.

B. Student should use the plot plan and produce a trench depth (along the run) consistent with the instructor's determination.

C. Student should solve problems of proper pipe support (hangers) from blueprint.

D. Student should be given a system to test. He will be required to select proper test and demonstrate his ability to properly perform that test.

E. Student will be evaluated upon his ability to replace (correctly fitted) sections of mock-up systems.

V. SUMMARY

A. As practicing plumbers, you will often be called upon to perform the tasks set before you today. Do not fail to take every chance you get to improve your skill to estimate, build, test or repair. Always remember the better you want to be, the better you will be.

VI. SUGGESTED TIME AND SEQUENCE LISTING

10 minutes -- Introduction

90 minutes -- The practice of estimates

125 minutes -- Laboratory experience--hangering, testing and fitting

115 minutes -- Integrated curriculum concepts

20 minutes -- Summary and evaluation

VII. SUPPLEMENTAL REFERENCES AND RESOURCE MATERIAL

1) Babbitt, Harold E., Plumbing, Bulletin No. 143, Urbana, Ill.: University of Illinois, Engineering Experiment Station, no date.

2) Cosgrove, John J., Plumbing, Pittsburgh, Pa.: Standard Sanitary Manufacturing Company, no date.

3) Dawson, Francis M. and Bowman, J. S., Water Supply Piping for Residential Buildings, Madison, Wis.: University of Wisconsin, Engineering Experiment Station, Series No. 77, no date.

INSTRUCTOR'S UNIT PLAN

Unit 7
Lesson 1
Time 6 Hours

CLUSTER: CONSTRUCTION

DIVISION: PLUMBING

SUBJECT: Systems Design and Materials Used

AIM:

To have the student become able to draw a total house (small) system including hot, cold and sewer system. The student will now become able to design, choose materials for and install proper waste lines and make proper connections of the simple systems.

INSTRUCTIONAL AIDS:

Film - Down the Drain, Cleveland: Chase Brass & Copper Company, Advertising Department, 20600 Chagrin Blvd. (16 mm, 11 minutes).

Film - Cast Iron Biography of a Metal, Pittsburgh, Pa.: Bureau of Mines, U. S. Department of the Interior, Motion Pictures, 4800 Forbes Avenue (16 mm, 27 minutes).

Preselected locally designed blueprint without plumbing but otherwise dimensioned.

Pieces of copper and cast iron pipe to discuss and support films.

Piece of clay pipe to show and discuss with the students.

EQUIPMENT:

16 mm projector and screen, cutting, threading and measuring tools, clay pipe sections plus cement for joints.

PRIMARY REFERENCES:

1) Blendermann, Louis, Design of Plumbing and Drainage Systems, New York: Industrial Press, Inc., 1963, 2nd Edition.

2) Cosgrove, John J., Plumbing, Pittsburgh, Pa.: Standard Sanitary Manufacturing Company, no date.

3) Slater, Harry, Plumbing, Related Information 1, Albany, New York: Delmar Publishers, Inc., 1958.

4) Starbuck, Robert M., Sanitary Plumbing, Vol. III, Hartford, Conn.: R. M. Starbuck & Sons, Inc., 1954.

I. INTRODUCTION AND MOTIVATION

A. Introduce and show films. A discussion of the good and poor points of each product should follow. Ceramic tile, its good and poor points, should then be compared to the two metal pipes. That each has its best-use place should be discussed.

B. The design of a total system (sketch in) for a small house, excluding heat, should be discussed with the student, which would include a review of prior lessons.

C. Again, the student must have practiced application. This time with different mediums--that of ceramic pipe, copper (large) and gray iron.

II. PRESENTATION OF INTEGRATED CONCEPTS

		RELATED CONCEPTS
INSTRUCTIONAL TOPICS	***TECHNICAL CONCEPTS***	***SCIENCE***
A. Design small house systems cold water system.	1. Design complete cold water system. a. Proper connection to service entrance b. Shortest runs, least use of pipe, best use of pipe c. Proper selection of materials including fixtures and valving to assure adequate supply at all points under all conditions d. Installation of proper air chambers to prevent hammer	1. Effects of household acids and detergents upon: a. Copper b. Cast iron c. Ceramic (as in ceramic pipe) d. Stainless steel e. Lead f. Demonstrate the corrosive action of acids on metals g. Demonstrate the clogging action of soaps and detergents
B. Design small house systems hot water system.	1. Design complete hot water system. a. Proper connection to cold water source b. Shortest runs, least use of pipe, best use of pipe c. Proper selection of materials including fixtures and valving to assure adequate supply at all points under all conditions d. Estimated demand determining proper hot water tank selection	1. Study of hard and soft water. a. What makes each b. Isolation of materials from waters c. Harmful effects of water-borne materials (i.e.: alkali, earth salts, etc.) d. Water-softening agents e. Demonstrate tests for hardness f. Demonstrate softening procedures
C. Design small house system sewage system.	1. Design complete one-kitchen, one-bath and laundry room waste system. a. Proper connection to each household fixture b. Selection of proper materials 1) Traps 2) Roughing-in materials 3) Proper grading 4) Proper and adequate venting 5) Proper setting of fixtures and bowls	1. Production of bacteria and effect of household waste on this production. a. Too few solids with too much liquid b. Too much grease or fat type of discharge c. Effect of light on production d. Effect of aided production of bacteria
D. Sewage disposal materials and connections.	1. Materials. a. Copper b. Gray iron c. Ceramic pipe d. Grading 1) Proper fall 2) Proper support e. Problems of weight during and after repairs f. Connections--nonmetal 1) Materials 2) Proper method 3) Testing methods 4) Vents and traps using these materials	1. Ore reduction. a. Crushing b. Washing--settling c. Purification

TO BE DEVELOPED

MATH	COMMUNICATIONS	SOCIAL STUDIES
1. How to make an estimate. a. Factors involved 1) Materials 2) Labor 3) Site location (transportation) b. Reduction to cost/unit 1) Unit cost a) Materials b) Labor c) Transportation d) Overhead 2) Reasonable profit	1. Basic communication skills. a. Reading skills by directed reading activities b. Grammatical skills by using textbook and by evaluating written work they have produced in their notebooks	1. Copper. a. Deposits throughout the world b. Deposits within the United States c. How is ore obtained
1. Reduction to format. a. Cost per unit/total units b. Total cost	1. Cover letter for estimate. a. Factors upon which estimate was made b. Reasons concerning choice of materials c. Reasonable expectations as to date to be completed d. Pleasant handling of public (i.e.: 1) Thanks for consideration 2) If not chosen, please consider in future 3) Look forward to helping)	1. Ore reduction. a. Where accomplished b. Methods utilized by industry
1. Awarded contract. a. Completed job 1) Figures furnished in jumbled presentation as to cost/unit; total units used statements 2) Students to reduce statements to properly formated bill for contractor (or individual)	1. Study of contracts and their meaning. a. Language b. How language changes word meaning c. Contracts often have printing of different sizes. Read all before doing anything.	1. Smeltering process. a. Where accomplished b. Methods utilized by industry 1) More than one 2) End product produced
1. Student to set up double entry books. a. Ordered--received b. Billed--payed outgoing c. Billed--payed incoming d. Billed--cost--profit	1. Study of abbreviations. a. Federal government b. On checks c. Industry 1) Building 2) Plumbing	1. History of copper. a. First use b. Effect upon civilization c. Industrial developments d. Impact upon the civilization of today

INSTRUCTIONAL TOPICS	TECHNICAL CONCEPTS	RELATED CONCEPTS SCIENCE
E. Fitting allowances and angles.	1. Proper alignment. a. How to compute using ceramic materials 1) Angles 2) Allowances 3) Proper support	1. Gases produced from solid waste. a. Identification b. Dangers 1) Health 2) Explosion 3) Pollution
F. Practical application.	1. Compute and install: a. Copper (miniature) sewage system b. Cast iron (miniature) sewage system c. Ceramic (miniature) sewage system	

TO BE DEVELOPED

MATH	*COMMUNICATIONS*	*SOCIAL STUDIES*
1. Wages. a. Individual income 1) Hours--straight 2) Hours--overtime 3) Total 4) Per hour/total hours = income b. Payroll 1) Individual a) Taxes 1) Income a) State b) Federal c) City d) Other 2) FDIC b) Due--taxes = wage	1. Page for booklet for layman on: a. Copper pipe b. Cast iron pipe c. Ceramic pipe d. Individual personal preference (explain for use in a waste system)	1. Lists of use by countries. a. Highly technical b. Medium technical c. Low technical (Note: This will, as of a necessity, be a research-type project.)

III. APPLICATION

A. Provided for within the lesson.

IV. EVALUATION CRITERIA GUIDELINE

A. The several projects provided for within the lesson should be evaluated for their step-by-step proper, accurate and professional workmanship.

V. SUMMARY

A. You have been introduced to the first design problem as well as repair problems. The bottom steps to the stairs have been investigated; now you must climb the stairs to the knowledge level that will make you a fully qualified plumber. It is work, but the type that rewards you with good feeling when you see your own well-designed, functional system in operation.

VI. SUGGESTED TIME AND SEQUENCE LISTING

60 minutes -- Introduce, show and discuss films

60 minutes -- Design of small house systems

110 minutes -- Laboratory experiences producing systems

110 minutes -- Integrated curriculum concepts

20 minutes -- Summary and evaluation

VII. SUPPLEMENTAL REFERENCES AND RESOURCE MATERIAL

1) Blendermann, Louis, Design of Plumbing and Drainage Systems, New York: Industrial Press, Inc., 1963, 2nd Edition.

2) Davis, Paul, Plumbing, Heating and Piping Estimator's Guide, New York: McGraw-Hill Book Company, no date.

3) Dawson, Francis M. and Bowman, J. S., Water Supply Piping for Residential Buildings, Madison, Wis.: University of Wisconsin, Engineering Experiment Station, Series No. 77.

4) Dibble, Samuel Edward, Elements of Plumbing, New York: McGraw-Hill Book Company, no date.

INSTRUCTOR'S UNIT PLAN

Unit 8
Lesson 1
Time 6 Hours

CLUSTER: CONSTRUCTION

DIVISION: PLUMBING

SUBJECT: Residential Sewage Systems

AIM:

To have the student study in depth the requirements of the individual home and how he can best utilize available materials for the construction of the waste disposal systems.

INSTRUCTIONAL AIDS:

Film - What Happened to Harry?, Columbus, Ohio: Ohio State University, Motion Picture Division, Townsend Hall, Room 113, 1885 Neil Avenue, Attention William A. Drake (16 mm, 20 minutes).

Filmstrip - Identification of Pipe and Fittings, Urbana, Ill.: University of Illinois, Vocational Agriculture Service, 434 Mumford Hall, Attention Prof. M. Henderson (74 frames).

Typical city permit for work, drawings to demonstrate "Y" location, and demonstration objects as considered necessary by the instructor.

EQUIPMENT:

16 mm projector and screen, filmstrip projector.

PRIMARY REFERENCES:

1) Dibble, Samuel Edward, Elements of Plumbing, New York: McGraw-Hill Book Company, no date.

2) Matthias, A. J., Jr. et al., How to Design and Install Plumbing, Chicago: American Technical Society, 1968.

3) Slater, Harry, Plumbing, Related Information 1, Albany, New York: Delmar Publishers, Inc., 1958.

4) Starbuck, Robert M., Sanitary Plumbing, Vol. III, Hartford, Conn.: R. M. Starbuck & Sons, Inc., 1954.

I. INTRODUCTION AND MOTIVATION

A. Introduce and show film. Discuss contents of film relating to necessity for careful, thoughtful work.

B. Introduce and show filmstrip. This filmstrip should be reviewed with the thought in mind that available materials and equipment must be reviewed and discussed often. Since that is the case, the drawing, permits and materials are investigated in further depth.

II. PRESENTATION OF INTEGRATED CONCEPTS

RELATED CONCEPTS

INSTRUCTIONAL TOPICS	*TECHNICAL CONCEPTS*	*SCIENCE*
A. House sewers.	1. Connecting to main. a. Permits b. Location of indicated "Y" connection c. Grade establishment d. Proper joints e. Inspections f. Backfill	1. Water testing. a. Hardness--softness b. Bacteria count c. Federal level of purification
B. House drain appliances.	1. Utilization. a. House trap b. Drains c. Catch basin d. Blow-off basin e. Receptor f. Pump g. Siphon	1. Methods of purification. a. Chemical b. Air c. Natural d. Filtration e. Sedimentation
C. Storm drainage.	1. Utilization. a. Materials b. Type c. Installation d. Sizing e. Leaders f. Terminals	1. Water storage. a. Changes due to storage b. Evaporation c. Natural contamination d. Man-made contamination (Note: Even in protected watershed areas)
D. Soil pipe.	1. Utilization. a. Joints b. Supports c. Connections d. Sizing e. Branches f. Terminals	1. Private--industrial water softeners. a. Contents b. Action
E. Waste pipe.	1. Utilization. a. Materials b. Fittings c. Sizing d. Installation e. Application to fixtures	1. Ceramics. a. Identification b. Forming c. Porosity d. Kiln

TO BE DEVELOPED

MATH	*COMMUNICATIONS*	*SOCIAL STUDIES*
1. Percentage. a. Percent to decimal b. Decimal to percent c. Review meaning of percent	1. Cover letter for plans requesting construction permit for system.	1. Obtaining water. a. Rivers b. Lakes c. Wells 1) Artesian 2) Pumped d. 1965 federal funds made available for development of large-scale desalinization plants
1. Units of measure. a. Addition b. Subtraction c. Review conversion of measuring units d. Emphasize the necessity of uniformity of units in mathematical operations	1. Pages in booklet that explain: a. Water hardness b. Methods of softening c. Responsibility 1) State 2) City 3) Individual 2. Write to companies in the area to ascertain their problems with water hardness.	1. Wells. a. Hand driven b. Hand drilled c. Slack line d. Rotary
1. Computation of labor cost. a. Man-hours 1) One man 2) Two men 3) Groups b. Cost/man-hour 1) One man 2) Two men 3) Groups	1. Basic reading skills. a. Read brochures from water softening companies	1. Study of strata. a. Top soil b. Clay c. Shale d. Rock e. Sand f. Water level variants
1. Multi-unit. a. Multiplication of lengths b. Multiplication of flow c. Division of flow	1. Basic language skills. a. Textbook b. Oral skills describing properties of water or role playing salesman of water softening systems	1. Casing. a. Why necessary b. Types c. Where obtained d. Perforations
1. Compile reference tables. a. Avoirdupois weight b. Cubic measure c. Linear measure d. Liquid measure e. Metric measure of capacity f. Metric measure of length g. Metric measure of weight h. Square measures	1. Letter covering why the individual desires the vocation of plumbing.	1. Well purity. a. Purity determination (See Science) b. Possible contamination 1) Disposal distances required by law 2) Testing requirements

II. PRESENTATION OF INTEGRATED CONCEPTS

INSTRUCTIONAL TOPICS	TECHNICAL CONCEPTS	RELATED CONCEPTS SCIENCE
F. Traps.	1. Utilization. a. Materials b. Size c. Types d. Installation	
G. Ventilation.	1. Utilization. a. Trap seal b. Siphonage c. Back pressure d. Methods e. Material f. Sizing g. Installation	1. Result of lack of oxygen. a. Using an "S" type trap, create vacuum on a view chamber which contains a plant b. Record result of lack of oxygen exposure on plant over a period of time c. Relate result to trap seals and result of lack of oxygen on any system operation

TO BE DEVELOPED

MATH	COMMUNICATIONS	SOCIAL STUDIES
1. Increasing potential flow by pipe sizes.		1. Water level tests. a. Pumping tests b. Result of over-pumping c. Without water, the earth would be a lifeless planet, like the moon. Uneven distribution of water is one of our chief problems.

III. APPLICATION

A. Student will be required to sketch a drawing of the proper installation of a sewer line from a house to a sewer "Y" located six feet below and 75 feet from the house stub to the sewer "Y." All symbols for connections, grades and trenching should be correctly annotated.

IV. EVALUATION CRITERIA GUIDELINE

A. Identify the difference between a soil pipe and a waste pipe.

B. Building permits are obtained from _______.

C. Before back-filling in sandy soil, you must _______.

D. Exterior basement drain systems are normally _______ type of pipe.

E. A back siphon is _______.

F. When constructing a system as the pipe is installed, attention must be given to the _______ or the system will collapse.

G. Include consideration of sketch required in the application step.

V. SUMMARY

A. Your knowledge of proper procedures and materials is growing and being reinforced. Attention must be constantly given to the theory as well as the practical side of plumbing so you will be able to troubleshoot and repair systems as well as select proper materials and install new systems.

VI. SUGGESTED TIME AND SEQUENCE LISTING

60 minutes -- Film and filmstrip introduction, showing and discussion

165 minutes -- Laboratory experience--obtaining permits, selection of materials, design and digging of trenches for sewer line

115 minutes -- Integrated curriculum concepts

20 minutes -- Summary and evaluation

VII. SUPPLEMENTAL REFERENCES AND RESOURCE MATERIAL

1) Babbitt, Harold E., Plumbing, New York: McGraw-Hill Book Company, 1960, 3rd Edition.

2) Blendermann, Louis, Design of Plumbing and Drainage Systems, New York: Industrial Press, Inc., 1963, 2nd Edition.

3) Davis, Paul, Plumbing, Heating and Piping Estimator's Guide, New York: McGraw-Hill Book Company, no date.

4) Liebers, Arthur, Plumber, New York: Arco Publishing Company, 1947, 1957, 1960.

INSTRUCTOR'S UNIT PLAN

Unit 9
Lesson 1
Time 6 Hours

CLUSTER: CONSTRUCTION

DIVISION: PLUMBING

SUBJECT: Cold Water Distribution Systems and Residential Floor Plans

AIM:

To have the student investigate in depth the materials, methods and requirements for the proper installation of cold water systems. This will be the basis for drawing detailed room installation drawings of floor drains and the rough-in of the system drains.

The student should gain a knowledge of the actual rough-in plumbing procedures during the application step of the lesson.

INSTRUCTIONAL AIDS:

Film - Copper, The Oldest Modern Metal, New York: Association Films, Inc., Executive Office, 600 Madison Avenue (16 mm, 27 minutes).

Film - Don't Build Hazards Into Your Tubing Systems, Chicago: Imperial-Eastman Corporation, Advertising and Sales Promotion, 6300 West Howard Street, Attention Mr. C. H. Peels, Manager (16 mm, 20 minutes).

Floor plans, as required.

Assorted materials and joints as required by the instructor.

EQUIPMENT:

16 mm projector and screen.

Tools, pipe, heaters, traps and related equipment necessary to carry out the application step, drawing equipment necessary to carry out the drawing step.

PRIMARY REFERENCES:

1) Dibble, Samuel Edward, Elements of Plumbing, New York: McGraw-Hill Book Company, no date.

2) Matthias, A. J., Jr. et al., How to Design and Install Plumbing, Chicago: American Technical Society, 1968.

3) Slater, Harry, Plumbing, Related Information 1, Albany, New York: Delmar Publishers, Inc., 1958.

4) Starbuck, Robert M., Sanitary Plumbing, Vol. III, Hartford, Conn.: R. M. Starbuck & Sons, Inc., 1954.

I. INTRODUCTION AND MOTIVATION

A. Introduce, show and discuss films. These films should be used to bring to the student's attention that the lessons are designed to cover lightly then re-cover in depth the individual systems and procedures.

II. PRESENTATION OF INTEGRATED CONCEPTS

		RELATED CONCEPTS
INSTRUCTIONAL TOPICS	*TECHNICAL CONCEPTS*	*SCIENCE*
A. Materials and methods of water distribution.	1. Materials and computation. a. Cast iron b. Wrought iron c. Copper d. Lead (discharge only) e. Block tin f. Joints g. House service h. Sizing i. Computing demand	1. Chemical reactions. a. Household detergents upon metals (as used in pipes) b. Household plumbing system cleaners effect upon metals (as used in pipes) c. Possible wear of liquids upon metal d. Dangers and drawbacks of plumbing system cleaners
B. Installation.	1. Installation procedures. a. Stops b. Meters c. Tapping the main	1. Moving and stagnant results of chemicals when in contact with metals. a. Scale formation in steam pipe causing heat loss b. Damage produced in water systems by hard water
C. Cold water distribution.	1. Installation. a. Supply b. Risers c. Valves d. Grading e. Insulation f. Pumps g. Types and operation h. Air pressure systems i. Overhead systems	
D. Floor plans.	1. Drawings. a. Laundry tray and floor drain in basement b. Kitchen floor plan c. Bathroom floor plan d. Rough-in for kitchen sink e. Rough-in for lavatory f. Rough-in for water closet g. Rough-in for bathtub and shower	1. Movements of solids in a liquid medium. a. Settle rate b. Oil--grease--fats emulsion--separation c. Suds (ability to reduce)
E. Application.	1. Drawing. a. Kitchen floor plan b. Bathroom floor plan	1. Bacteria cultures using: a. Oils b. Grease c. Fats d. Seal and sit back. Make two--one for darkness and one for sunlight. Record results.

TO BE DEVELOPED

MATH	COMMUNICATIONS	SOCIAL STUDIES
1. Triangles. a. Terms 1) Normal 2) Piping	1. Letters to special tool and equipment suppliers requesting catalogs. a. Heating equipment for lead, etc. b. Saws, both power and hand c. Packing tools d. Test equipment	1. Manufacture of copper tubing and pipe. a. Where mills are located b. Process of manufacture
1. Triangles based on fittings. a. 22-1/2° fittings b. 45° fittings c. 60° fittings	1. Page for booklet. a. Explaining reasons cold water lines must be insulated b. Problems if the cold water lines are not insulated	1. Methods of shipping. a. Selection b. Movement pattern from city of mfg to city of use and then to the job
1. Weights of liquids contained by piping and tubing. a. Weight of liquids by specific gravity b. Weight of liquids by volume	1. Page for booklet (for layman). a. Explain the use of a meter in the system b. Explain how a meter does its measuring	1. Effects of employee strike. a. Transportation b. Mill c. Job site 2. First compulsory arbitration law passed in 1963 to head off a threatened nationwide railroad strike.
1. Areas of circles and squares and combinations. 2. Volumes of spheres, cubes and other solids.	1. Basic reading and writing skills help.	1. Economic impact of strike. a. Transportation b. Mill c. Job site d. Related businesses and industry e. Types of strikes 1) Sit-down 2) Wildcat 3) Slowdown 4) Sympathy 5) General
1. Cubic feet to cubic yards and cubic yards to cubic feet.	1. Letter explaining why a laundry tub in the basement should be replaced and the procedure for replacing it to an individual that requested examination and recommendation. 2. Telephone conversation covering above information.	1. Codes. a. Who establishes b. Why established c. Levels 1) Federal 2) State 3) Local

II. PRESENTATION OF INTEGRATED CONCEPTS

INSTRUCTIONAL TOPICS	TECHNICAL CONCEPTS	RELATED CONCEPTS SCIENCE
F. Rough-in application.	1. Rough-in (single). a. Typical kitchen b. Typical bathroom	1. Human hair: a. Attempt reduction with common household chemicals b. Flow pattern through strainers, settlement systems c. Effect on drains and pumping systems

TO BE DEVELOPED

MATH	*COMMUNICATIONS*	*SOCIAL STUDIES*
1. Cost of cubic foot (yard) movement by equipment and by manpower. a. Compare b. Most inexpensive method		1. No code--possible effect. a. Contamination b. Confused and poor workmanship

III. APPLICATION

A. Provided for during the laboratory time.

IV. EVALUATION CRITERIA GUIDELINE

A. Close attention should be paid to the drawings submitted.

B. Rough-in by the student should be closely monitored and on-the-spot corrections carried out.

C. Questions:

1. Name the most common type trap used in the plumbing system.
2. The meter actually measures _______ and is read in _______ _______.
3. Name two types of supply systems.
4. The term "rough-in" means _______.
5. What size pipe would you use to allow a 100-gallon per minute flow?

V. SUMMARY

A. You have returned to review some of your drawing by sketching a floor plan for a kitchen and a bathroom. You can see the fact that you are repeating certain factors but studying them in greater depth each time. Don't become lax for each step needs to have a solid foundation or it will not withstand the steps of time.

B. Remember also that you should be looking for jobs to study and new methods of doing things.

VI. SUGGESTED TIME AND SEQUENCE LISTING

70 minutes -- Films: Introduction and discussion

155 minutes -- Laboratory experience--making of drawing and rough-in of one of the mockup units

115 minutes -- Integrated curriculum concepts

20 minutes -- Summary and evaluation

VII. SUPPLEMENTAL REFERENCES AND RESOURCE MATERIAL

1) Babbitt, Harold E., *Plumbing*, New York: McGraw-Hill Book Company, 1960, 3rd Edition.

2) Blendermann, Louis, Design of Plumbing and Drainage Systems, New York: Industrial Press, Inc., 1963, 2nd Edition.

3) Davis, Paul, Plumbing, Heating and Piping Estimator's Guide, New York: McGraw-Hill Book Company, no date.

4) Dull, Charles E., Modern Chemistry, New York: Holt, Rinehart & Winston, Inc., 1967.

5) Liebers, Arthur, Plumber, New York: Arco Publishing Company, 1947, 1957, 1960.

INSTRUCTOR'S UNIT PLAN

Unit 10
Lesson 1
Time 6 Hours

CLUSTER: CONSTRUCTION

DIVISION: PLUMBING

SUBJECT: Heating Systems

AIM:

To have the student gain a knowledge of the hot water (non-heating) system, its construction and installation. The student will then progress to the liquid heating systems that furnish heating to the commercial building or the home.

INSTRUCTIONAL AIDS:

Film - Story of Radiant Heating, The, Cleveland, Ohio: Chase Brass & Copper Company, Advertising Department, 20600 Chagrin Blvd. (16 mm, 15 minutes).

Film - Heat and Its Control, Pittsburgh, Pa.: Bureau of Mines, Central Equipment Station, 4800 Forbes Avenue, Attention Mr. Reiners (16 mm, 20 minutes).

Drawings and pictures of hot water installations, mock-up of system to display proper installation procedures.

EQUIPMENT:

16 mm projector and screen.

Hand tools, pipes, valves, heaters and other items that will allow the application step to be carried out.

PRIMARY REFERENCES:

1) Eisinger, L. (Ed.), Handyman's Plumbing and Heating Guide, New York: Arco Publishing Company, Inc., 1955.

2) Graham, Frank and Emery, T. J., Plumbers and Steam Fitters Guides, Indianapolis: Theodore Audel, no date.

3) Matthias, A. J., Jr. et al., How to Design and Install Plumbing, Chicago: American Technical Society, 1968.

4) Slater, Harry, Plumbing, Related Information 1, Albany, New York: Delmar Publishers, Inc., 1958.

5) Starbuck, Robert M., Sanitary Plumbing, Vol. III, Hartford, Conn.: R. M. Starbuck & Sons, Inc., 1954.

I. INTRODUCTION AND MOTIVATION

A. Introduce, show and discuss films. Bring forth the modern convenience of the hot water automatically furnished for our use and the hot water systems used for our comfort by heating our homes.

B. There is a great deal to learn and only by close attention to detail can we hope to become good heating plumbers.

II. PRESENTATION OF INTEGRATED CONCEPTS

		RELATED CONCEPTS
INSTRUCTIONAL TOPICS	*TECHNICAL CONCEPTS*	*SCIENCE*
A. Hot water system.	1. Supply. a. Storage b. Heaters c. Circulation d. Control e. Distribution	1. Review heat transfer. a. Radiation b. Conduction c. Convection
B. System connections.	1. Cross connection and contamination.	1. Best mediums for heat transfer. a. Liquid b. Air c. Metal 2. Discuss concept of specific heat.
C. Specifications.	1. Specifications. a. Job b. Material	1. Sources of heat. a. Hydrocarbons 1) Oil 2) Coal 3) Wood 4) Sun
D. Heating system introduction.	1. History. a. First use b. Evolution of steam and hot water for heating c. Practice of heating and ventilating d. Heating standards and temperatures required	1. Review of solar energy heating system.
E. Heat.	1. Nature of heat. a. How measured (BTU) b. How transmitted c. Radiating power of bodies d. Absorption of heat	1. Heat all comes from sun. a. Plant and animal growth b. Still causing heat plus allowing energy to be stored in wood
F. Artificial heating apparatus.	1. Evolution. a. Open fireplace b. Stoves c. Furnaces d. Steam e. Hot water f. Vapor g. Average cost and life h. Healthfulness i. Easy type of boilers j. Steam boilers k. Hot water heaters l. Modern heating boilers m. Smokeless boilers n. Wrought iron or steel boilers o. What makes a good boiler	1. Combustion. a. Requirements b. By-products of combustion c. Kindling temperature d. Efficiency factors

TO BE DEVELOPED

MATH	COMMUNICATIONS	SOCIAL STUDIES
1. Review triangles. a. $T^2 = A^2 + O^2$ b. Use of metal square in determining hypotenuse	1. Write a short history, after proper research, of evolution of the present liquid heating system.	1. Heating systems. a. Effect of locale b. Locale effect of choice of fuels
1. Squaring numbers and taking the square root of numbers.	1. Assume a friend had written the student that his non-heating system hot water tank had failed. Have the student construct a letter telling the friend how to go about replacing the tank.	1. Study of location of fuels. a. By areas b. Transportation systems c. Effect of technology on development of fuels and their transportation
1. Square area. a. With cutouts 1) Rectangular 2) Triangular 3) Circular	1. Page for booklet. After proper research, have the student write the job requirements of a hot water heating system plumber.	1. Weather and heating system effect upon clothing of the culture.
1. Circumference of a circle. a. Given radius, calculate circumference b. Given circumference, find radius	1. Discussion of the role of safety in industry. 2. Page for booklet. Write a brief set of safety rules to be observed by a person not a plumber while in a heating shop. 3. Over a specified time, keep note of any violations of safety rules among other students or instructors. Discuss.	1. Weather and heating system effect upon food selection and growth.
1. Gallons to cubic feet; cubic feet to gallons. 2. Relate pipe capacity in cubic feet/min. to cross sectional area.		1. Heating system effect upon the style of housing in any given culture.
1. Introduction to tables. a. What they are b. Where they are used c. Why they are used		1. Heating systems effect upon the health of a culture.

II. PRESENTATION OF INTEGRATED CONCEPTS

INSTRUCTIONAL TOPICS	TECHNICAL CONCEPTS	RELATED CONCEPTS SCIENCE
G. Application.	1. Hot water (non-heating) system. a. Sketch drawing of hot water system for single home b. Furnish cold water to heater and hot water from heater to kitchen, bath and laundry (home sketch supplied) c. Select fuel for heater. Determine supply potential from sketch and drawing	1. Study of insulation. a. Comparison 1) With 2) Without b. Insulation types 1) List in order of porosity 2) Effect of compaction
H. Application.	1. System: a. Produce system using mock-up equipment supplied b. Test system to insure leakproof	1. Study a home heating system and determine fuel use before and after insulation has been added.

TO BE DEVELOPED

MATH	*COMMUNICATIONS*	*SOCIAL STUDIES*
		1. Efficient heating systems have made it possible for man to live and work in the cold regions of the world. 2. Problems with ecology when heating systems are considered.

III. APPLICATION

A. Provided for in the body of the unit.

IV. EVALUATION CRITERIA GUIDELINE

A. Evaluate closely the sketches submitted covering the proposed hot water installation.

B. Evaluate closely the system installed in the mock-up.

C. Questions:
   1. Name the two hot water systems located in many homes and commercial buildings.
   2. What is a BTU?
   3. What are the three ways heat is transferred?
   4. Boiling water gives off _______ which is also a system for heating.
   5. Name three types of fuel that can be used in hot water heaters.

V. SUMMARY

A. You have started the study of heating systems. Due to the temperatures, you should be more careful than you were before. Heating systems can make one comfortable, but poor workmanship can make the system useless.

VI. SUGGESTED TIME AND SEQUENCE LISTING

50 minutes -- Introduction and discussion of films

175 minutes -- Laboratory experiences--demonstration, discussion and application

115 minutes -- Integrated curriculum concepts

20 minutes -- Summary and evaluation

VII. SUPPLEMENTAL REFERENCES AND RESOURCE MATERIAL

1) Eisinger, L. (Ed.), Handyman's Plumbing and Heating Guide, New York: Arco Publishing Company, Inc., 1955.

2) Lewis, Samuel R., Sizing Pipes for Plumbers, Scranton, Pa.: International Textbook Company, no date.

3) Oravetz, Jules, Plumbers and Pipe Fitters Library, Indianapolis: Theodore Audel, 1967.

4) Thomson, Thomas N., Brass Pipe, A Handbook, New York: Copper and Brass Research Association, no date.

INSTRUCTOR'S UNIT PLAN

Unit 11
Lesson 1
Time 6 Hours

CLUSTER: CONSTRUCTION

DIVISION: PLUMBING

SUBJECT: Boilers and Chimneys

AIM:

To have the student develop an understanding of the boiler and its proper venting with a properly designed chimney. The student should be able to design, install and repair a proper chimney for a given boiler design.

The student should gain an understanding of the control of a boiler and the problems and control of those problems through the devices available from the industry.

INSTRUCTIONAL AIDS:

Film - Heat and Its Control, Pittsburgh, Pa.: Bureau of Mines, Central Experiment Station, 4800 Forbes Avenue, Attention Mr. Reiners (16 mm, 20 minutes).

Film - Heat: The Science and Economics of Its Control, Pittsburgh, Pa.: Bureau of Mines, Central Experiment Station, 4800 Forbes Avenue, Attention Mr. Reiners (16 mm, 26 minutes).

Pictures and diagrams of selected boilers.

Valves, fusible plugs, radiator types in addition to other devices considered necessary to properly demonstrate the control of boilers.

EQUIPMENT:

16 mm projector and screen.

Assorted tools to disassemble and reassemble the demonstration equipment.

PRIMARY REFERENCES:

1) Graham, Frank and Emery, T. J., Plumbers and Steam Fitters Guides, Indianapolis: Theodore Audel, no date.

2) Matthias, A. J., Jr. et al., How to Design and Install Plumbing, Chicago: American Technical Society, 1968.

3) Slater, Harry, Plumbing, Related Information 1, Albany, New York: Delmar Publishers, Inc., 1958.

4) Starbuck, Robert M., Sanitary Plumbing, Vol. III, Hartford, Conn.: R. M. Starbuck & Sons, Inc., 1954.

I. INTRODUCTION AND MOTIVATION

A. Introduce, show and discuss the films. The introduction should clearly bring out facts concerning proper choice as well as installation of boilers determining the proper satisfactory operation of the system as well as determining its life expectancy. The safety of such a system is a function of proper relief and shutdown in case of an emergency; therefore, the controls will be introduced.

II. PRESENTATION OF INTEGRATED CONCEPTS

		RELATED CONCEPTS
INSTRUCTIONAL TOPICS	TECHNICAL CONCEPTS	SCIENCE
A. Boilers.	1. Surfaces and settings. a. Grate surface b. Water surface c. Boiler setting d. Construction of ashpits	1. Study of action of chlorine. a. The element b. Effect upon those things it is combined with c. Effect upon bacteria count in water d. Dangers and precautions in handling and use
B. Boilers.	1. Trimmings and fixtures. a. Safety valves b. Steam gauge c. Automatic damper regulators d. Water column and gauge glass e. Blow-off cock f. Fusible plug	1. Fluorine. a. The element b. Effect upon those things it is combined with c. Effect upon bacteria count in water d. Study of research work and result upon tooth decay e. Chemical properties as the most active non-metal
C. Chimney.	1. Elements. a. Sizes of chimney b. Height of chimney c. Elements of a good flue d. Common sources of chimney trouble	1. Water. a. Effect upon surfaces the water is in contact with when heated (deposits) b. Scale deposits removal processes (not removing pipe)
D. Pipes and fittings.	1. Characteristics and handling. a. Sizes of pipe b. Threading of pipe c. Bending of pipe d. Expansion of pipe e. Measuring pipes and fittings	1. Pollution caused by: a. Burning fuels b. Overflow escaping liquids c. Flyash content of certain fuels d. Poisonous by-products of typical combustion processes
E. Controls.	1. Valves. a. Standard radiator valves b. Packless radiator valves c. Special hot water radiator valves d. Graduated radiator valves e. Glove and gate valves f. Check valves	1. Liquids compressibility in different forms. a. Liquid b. Gas c. Solids

TO BE DEVELOPED

MATH	COMMUNICATIONS	SOCIAL STUDIES
1. Graphs. a. Determine what they are b. Construction c. What they can be made to show	1. Basic skills in training and vocabulary of the trade.	1. Study of locations of use of stationary and movable boilers. a. Stationary b. Movable (i.e. railroad) c. History of why the movable boiler has declined in one nation while remaining a large factor in another
1. Practical application. a. Construct a chart of length, width and depth of ditch vs. the cubic feet of earth removed	1. Booklet pages. a. Explain how the boiler operates b. Comparative advantages/disadvantages of the types of fuels that could be used c. Explain rules for choice of heater/heating system for an individual 2. Library research and reading on the discovery, development and use of various fuels.	1. Industries that utilize boilers. a. Use as a source of power b. Other uses
1. Construct a graph showing heat loss per foot of pipe running through the outside air	1. Report by groups. a. How to test a flue/chimney b. How to determine if a chimney is correct height	1. Fuels. a. Location of fuels b. Determining factors that select fuel c. Efficiency of fuel as a determining factor
1. Tables. a. What are they b. How are they constructed c. What can they be made to show	1. Compose a letter to the local (quality and best known) heating contractor asking him to appear and discuss the above subjects with the students.	1. Laws governing pollution. a. In U. S. b. Other nations c. Is international control needed d. Suggested methods of controlling pollution 1) Locally 2) Internationally
1. Practical application. a. Construct a table of decimal equivalents b. Construct a table showing the three drill size identification methods c. Other tables it is felt the student would be able to utilize the knowledge of	1. Discuss rules for and organization of debates, panel discussions and symposiums. 2. Debate: Hot water system vs. forced air system for house heating.	1. Why must laws on pollution be developed? a. Present problems b. Long-range problems 2. By the first half of the 20th century the U. S. found that industrial wastes were poisoning fish, contaminating drinking water, and polluting the air around large cities.

II. PRESENTATION OF INTEGRATED CONCEPTS

RELATED CONCEPTS

INSTRUCTIONAL TOPICS	TECHNICAL CONCEPTS	SCIENCE
F. Air control.	1. Valves. a. Compression air valves b. Automatic air valves c. Early type of automatic air valves d. Float and expansion types e. Modern automatic air valves f. Vacuum air valves	1. Short study of cultures placed in development vials in prior lesson.
G. Application.	1. Sketch a boiler making sure the details of the tubes and fire chamber are clear.	

TO BE DEVELOPED

MATH	COMMUNICATIONS	SOCIAL STUDIES
	1. Selection of panel leaders for discussion on the most desirable form of heat radiating system. Direct vs. indirect.	

III. APPLICATION

A. The student will be required to give the necessary components of a system during the evaluation step as well as being required to indicate his knowledge of various valves and the flue.

IV. EVALUATION CRITERIA GUIDELINE

A. List the least number of components, by name, that any operative boiler can have.

B. Briefly describe what a BTU is.

C. What is the difference between a gate valve and a globe valve?

D. Where is an altitude gauge used?

E. Can a relief valve be used in the place of a vacuum valve? Explain.

F. The flue size is determined by _______.

V. SUMMARY

A. You have discussed and learned the relationship between the boiler, its fuel and its heating ability. You have also learned how to control the boiler through the proper choice of valves and flues. When you are called upon to give an evaluation concerning boilers and heaters be careful and let it be said that you displayed a good knowledge of the boiler and its operation.

VI. SUGGESTED TIME AND SEQUENCE LISTING

70 minutes -- Introduction, showing and discussion of films

155 minutes -- Laboratory experiences

115 minutes -- Integrated curriculum concepts

20 minutes -- Summary and evaluation

VII. SUPPLEMENTAL REFERENCES AND RESOURCE MATERIAL

1) Eisinger, L. (Ed.), Handyman's Plumbing and Heating Guide, New York: Arco Publishing Company, Inc., 1955.

2) Lewis, Samuel R., *Sizing Pipes for Plumbers*, Scranton, Pa.: International Textbook Company, no date.

3) Starbuck, Robert M., *Modern Heating Illustrated*, Hartford, Conn.: R. M. Starbuck & Sons, Inc., no date.

4) Starbuck, Robert M., *Practice and Theory of Radiant Heating*, Hartford, Conn.: R. M. Starbuck & Sons, Inc., no date.

5) Starbuck, Robert M., *Questions and Answers on the Practice and Theory of Steam and Hot Water Heating*, Hartford, Conn.: R. M. Starbuck & Sons, Inc., no date.

INSTRUCTOR'S UNIT PLAN

Unit 12
Lesson 1
Time 6 Hours

CLUSTER: CONSTRUCTION

DIVISION: PLUMBING

SUBJECT: Heat--Estimation and Dispersion

AIM:

To have the student gain knowledge in heating systems. The student should be able to identify the different systems as well as estimate heating needs, then be capable of determining the necessary capacity that will insure adequate heating under known temperature conditions.

INSTRUCTIONAL AIDS:

Charts of boilers and radiators.

Charts and drawings of valves, traps, pumps and other equipment used in the heating system.

EQUIPMENT:

Disassembled pumps, radiators and valves, and other selected units.

Heat source and selected materials to demonstrate heat transfer.

Operative model of boiler to demonstrate methods of firing and liquid circulation.

PRIMARY REFERENCES:

1) Graham, Frank and Emery, T. J., Plumbers and Steam Fitters Guides, Indianapolis: Theodore Audel, no date.

2) Matthias, A. J., Jr. et al., How to Design and Install Plumbing, Chicago: American Technical Society, 1968.

3) Slater, Harry, Plumbing, Related Information 1, Albany, New York: Delmar Publishers, Inc., 1958.

4) Starbuck, Robert M., Sanitary Plumbing, Vol. III, Hartford, Conn.: R. M. Starbuck & Sons, Inc., 1954.

I. INTRODUCTION AND MOTIVATION

A. The lesson before this concerned itself mainly with the boiler or source of a heating system. The heat generated in the boiler must be dispersed throughout a building, so now we will consider how to compute the necessary heat and how it can be dispersed.

II. PRESENTATION OF INTEGRATED CONCEPTS

	RELATED CONCEPTS	
INSTRUCTIONAL TOPICS	*TECHNICAL CONCEPTS*	*SCIENCE*
A. Radiating surfaces.	1. Forms. a. Early types of radiators b. Direct radiators c. Indirect radiators d. Modern types of cast iron radiators e. Pipe coils	1. Expansion. a. Of metals b. Of liquids c. Make a thermometer 1) Mercury 2) Other d. Differential expansion of a bimetallic strip e. Students to make water thermometers
B. Location.	1. Radiating surface location. a. Locating direct radiators b. Locating indirect radiators c. Table sizes of air ducts d. Direct-indirect radiators e. Recessing radiators f. Wall radiators	1. Air pressure (atmosphere). a. Depth of air mantle b. Weight of air mantle c. Measurement thereof 1) Water manometer 2) Mercury manometer 3) Construct manometer d. Measure tests with manometer
C. Estimating radiation.	1. Estimation and heat. a. Heat losses 1) BTU loss through building construction 2) BTU loss through walls 3) BTU loss through glass 4) Infiltration and leakage b. Rules for estimating radiation 1) For steam 2) For hot water 3) For vapor c. BTU method of estimating radiation	1. Work with BTU. a. Determine heat from gas by measuring cubic flow and applying to known volume of water b. Experiment with heating rate in relation to a closed then open heating vessel c. Using student-instructor selected fuels, experiment to find BTU content of different fuels

TO BE DEVELOPED

MATH	COMMUNICATIONS	SOCIAL STUDIES
1. Formulas. a. Area b. Volume c. Circle circumference d. Volume to find U. S. gallons 1) Measurement in inches 2) Measurement in feet e. Volume in imperial gallons 1) Measurement in inches 2) Measurement in feet f. Area to feet or inches for single side g. Diagonal of rectangle when two sides are known h. Right triangle formulas i. Inches fall when line length (feet) and grade (inches per foot) have been given j. Grade (inches/foot) of line when length (in feet) and fall (total in inches) have been given k. Length (in feet) of line when given fall (in inches) and per foot grade	1. Basic skills drill. a. Spelling b. Structure c. Capitalization d. Reading	1. Soils within the United States. a. Stability b. Structure c. Draining requirements d. Desirable type and non-desirable type of piping to be used 2. Soil Conservation Service (1935) established to check and prevent erosion.
1. Basic mathematic skill drill.	1. Vocabulary of the trade. a. To person in the trade b. To person who is not in the trade 2. Discussion of different levels of communication. Relate social expectations to linguistic ability.	1. With soil types in mind a. Possible problems 1) Outdoor privy 2) Cesspools 3) Septic tank 4) Others b. Study of methods of overcoming the problems (as stated above)
1. Construct several graphs from information concerning: a. Heat expansion rates b. BTU loss rates c. Circulation flow of liquid due to heat and height d. Drill sizes, include fraction, decimal and letter sizes e. A liquid boiling temperature when subjected to vacuum then when subject to pressure	1. Given a specific problem (one that has been presented prior) explain to an individual (not in the trade) what must be done to correct the problem. The explanation must be technically correct.	1. Health problems associated with ineffective capability of each of the above.

II. PRESENTATION OF INTEGRATED CONCEPTS

RELATED CONCEPTS

INSTRUCTIONAL TOPICS	TECHNICAL CONCEPTS	SCIENCE
D. Apparatus.	1. Steam heating. a. One pipe system with wet or dry returns b. Relief system of one pipe steam heating c. Two pipe system d. Overhead system e. Circuit system f. Divided circuit system g. Efficiency in piping methods h. Sizes of steam mains i. Sizes of return mains j. Value of exhaust system k. Fixtures used with exhaust heating system	1. Fuel pollution agents that can be reduced by treatment. a. Sulphur content b. Particle precipitators c. Other
E. Condensation.	1. Return to boiler. a. By gravity b. Checkless method c. Returning condensate with traps d. Pumps e. Types of condensation pumps	1. Comparative evaluation of fuels as to their pollution values. 2. Pollution values vs. cost and efficiency.
F. Steam appliances.	1. Units. a. Steam traps b. Return traps c. Steam separators d. Feed water heaters e. Steam pumps f. Boiler feed pumps g. Vacuum pumps h. Pump governors and regulators i. Back pressure reducing valves j. Pressure reducing valves k. Injectors l. Inspirators m. Automatic water feeders	1. Liquid circulation by heating effect. a. Discovery of ability of liquid to do so b. Investigation of heights that system will operate c. Circulation of different liquids (i.e., distilled water vs. non-distilled)
G. Application.	1. Sketch a total boiler system. Include the following: a. Boiler b. Flue-chimney c. Fuel system d. Water feed system e. Heating liquid circulation system f. Materials/resources permitting the class should make a small operative boiler and system to implant the system in the individual mind	

TO BE DEVELOPED

MATH	COMMUNICATIONS	SOCIAL STUDIES
1. Volume flow through a pipe. a. How to discover b. Computation of flow c. Actual flow and why the difference	1. Pages for booklet. a. Boilers 1) Selection basis 2) Fuel choice 3) Chimney design b. Suggested criteria for selection of heating system 1) Non-pumped system 2) Pumped system	1. With expanding population problems connected with choice and proper care of each of the above systems (i.e., disposal of waste that has been removed from a septic tank or cesspool).
	1. Write a new resume explaining the increase in background, how it was secured and why the individual feels he is now better qualified to perform the necessary duties. 2. Check newspaper want ads to see what changes can be noted in the job market.	1. Begin collection of information on condition of rivers, bays and waterfront property and what the population has and is doing to despoil them.
		1. Begin collection of information concerning disposal of waste in our natural wildlife-national park areas. Questions concerning possible future problems as well as present problems should be the focal point of this study.

III. APPLICATION

A. Provided for within the lesson.

IV. EVALUATION CRITERIA GUIDELINE

A. The sketches should be checked carefully to insure the student has developed the proper system covering that which has been assigned or chosen by him.

B. One square foot of noninsulated wall will transfer how many BTU's per hour?

C. The direct radiator should be located _______.

D. The indirect radiator should be located _______.

E. Should radiators be recessed in walls? Why?

F. Describe infiltration and leakage as used in connection with the heating system.

V. SUMMARY

A. The boiler heating system has been studied. It can be readily seen that incorrect or careless installation can be dangerous. It is also true that improper selection of boiler as to size would be a waste due to overcapacity or many peopl would be cold if an undercapacity boiler was chosen. The total system of boiler, radiators and chimney must be in proper balance or large problem will result.

VI. SUGGESTED TIME AND SEQUENCE LISTING

20 minutes --	Introduction of lesson by overview and display of units to be studied in depth
205 minutes --	Study of the systems and construction of model boiler and/or system
115 minutes --	Integrated curriculum concepts
20 minutes --	Summary and evaluation

VII. SUPPLEMENTAL REFERENCES AND RESOURCE MATERIAL

1) Eisinger, L. (Ed.), Handyman's Plumbing and Heating Guide, New York: Arco Publishing Company, Inc., 1955.

2) Lewis, Samuel R., *Sizing Pipes for Plumbers*, Scranton, Pa.: International Textbook Company, no date.

3) Starbuck, Robert M., *Modern Heating Illustrated*, Hartford, Conn.: R. M. Starbuck & Sons, Inc., no date.

4) Starbuck, Robert M., *Practice and Theory of Radiant Heating*, Hartford, Conn.: R. M. Starbuck & Sons, Inc., no date.

5) Starbuck, Robert M., *Questions and Answers on the Practice and Theory of Steam and Hot Water Heating*, Hartford, Conn.: R. M. Starbuck & Sons, Inc., no date.

INSTRUCTOR'S UNIT PLAN

Unit	13
Lesson	1
Time	6 Hours

CLUSTER: CONSTRUCTION

DIVISION: PLUMBING

SUBJECT: Hot Water Heating Systems

AIM:

To further the student's knowledge of heating systems. The student will be instructed in additional types of systems to broaden his background and enable him to make more intelligent selection of the proper system for a given installation.

INSTRUCTIONAL AIDS:

Film - Welded Pipe, New York: American Gas Association, Film Service, 605 Third Avenue (16 mm, 18 minutes).

Pictures and charts of radiators, valves and components of the hot water heating system.

EQUIPMENT:

16 mm projector and screen.

Equipment for display showing components of system.

Tubing and joining equipment for constructing model system.

PRIMARY REFERENCES:

1) Graham, Frank and Emery, T. J., Plumbers and Steam Fitters Guides, Indianapolis: Theodore Audel, no date.

2) Matthias, A. J., Jr. et al., How to Design and Install Plumbing, Chicago: American Technical Society, 1968.

3) Slater, Harry, Plumbing, Related Information 1, Albany, New York: Delmar Publishers, Inc., 1958.

4) Starbuck, Robert M., Sanitary Plumbing, Vol. III, Hartford, Conn.: R. M. Starbuck & Sons, Inc., 1954.

I. INTRODUCTION AND MOTIVATION

A. This lesson continues the study of heating systems and home hot water service. It contains many references to individual units that have been encountered before but now they are used within a system. The film is about one method of manufacturing pipe. Introduce, show and discuss film--relate the study of pipe manufacture will continue later in the lesson.

II. PRESENTATION OF INTEGRATED CONCEPTS

RELATED CONCEPTS

INSTRUCTIONAL TOPICS	TECHNICAL CONCEPTS	SCIENCE
A. Appliances.	1. Hot water heating. a. Altitude gauge b. Hot water thermometer c. Pressure appliances d. Mercury generators e. Heat retainers	1. Insulation. a. Materials b. Structure of materials c. Methods of use d. Effect of use
B. Connections.	1. Radiators and pipe. a. Steam radiator connection b. Hot water radiator connections c. Improper use of ties d. Methods of pipe construction e. Artificial water line	1. BTU control a. Insulation of heat transfer substances 1) Metals--unpainted 2) Metals--painted b. Enclosure effect upon heat transfer 1) Partial 2) Complete with openings a) Side only b) Top only c) Both side and top
C. Pressure system.	1. Hot water heating. a. Expansion tank connections b. Methods of heating water c. Methods of piping d. Economical features e. For use by individuals of the household for hygiene and health	1. Check on cultures to determine: a. Reduction ability b. Effect of sunlight
D. Accelerated system.	1. Hot water heating. a. Advantages of accelerated methods b. Radiator tappings c. Methods of piping	1. Study of oxygen. a. For fire b. For human c. Effect of closed room (no ventilation) 1) On flame 2) Suggest effect upon human
E. Ventilation.	1. Ventilation. a. Importance of ventilation b. Air necessary for ventilation c. Methods of providing ventilation d. Special 1) School building ventilation 2) Non-mechanical methods 3) Aspirating vent flues 4) Exhaust fans	1. Gauge measurement. a. Absolute type b. Atmospheric type c. Control device for each d. What each gauge measures e. Construct aneroid and determine its use as a basis for an instrument

TO BE DEVELOPED

MATH	COMMUNICATIONS	SOCIAL STUDIES
1. Basic problems facing the individual when making fittings. a. Identify the fitting nomenclature again b. Identify the ℄ to ℄ type of measurement and face to face measurements c. Practical problems for straight line fittings	1. Basic skills drill. a. Vocabulary of the trade b. Spelling, punctuation, and use of capitals	1. Social-economic study. a. Level of income of median family b. By industry and trade level of income for members c. Income for apprentice, journeyman and master plumber in relation to other trades' income
1. Multifitting computation of piping. a. Face to face b. ℄ to ℄ of fitting c. Discussion of "overall" measurements	1. Letters to organizations producing trade goods requesting charts, pictures and other literature helpful to the classroom training.	1. Job openings. a. In industry b. In trades c. In plumbing
1. How to obtain "pipe make-up" distances. a. Define section identification of pipe and fitting intermate identification b. Identify and discuss the difference between "make-up" and "take-off" c. Problem of no "make-up" joints	1. Notebook pages defining: a. Turns b. Branches c. Wyes d. Take-up e. Make-up and other fitting terminology	1. Specialized training requirements. a. In industry b. In trades c. In plumbing
1. Practical problems.	1. Oral report. a. Vocabulary of the trade based on assigned words that had been assigned b. Use of a special tool that had been assigned	1. Specialized training available. a. In industry b. In trades c. In plumbing
1. Flanged fittings. a. Identification b. Distance identification c. Construct table of constants 1) Contains T, O, A 2) Angles 5-5/8, 11-1/4, 22-1/2; 30°, 45°, 60° and 72° fittings	1. Dictionary research to provide training in use of and to illustrate the limitations for technical vocabulary.	1. Other industry and trade vs. plumbing trades as a source of training and income.

II. PRESENTATION OF INTEGRATED CONCEPTS

		RELATED CONCEPTS
INSTRUCTIONAL TOPICS	*TECHNICAL CONCEPTS*	*SCIENCE*
F. Testing equipment.	1. Gauges (review of types, construction and use). a. Pressure b. Compound c. Temperature d. Vacuum e. Anemometer f. Gas analyzer g. Pyrometer	1. Study of thermocouples. a. Development of electrical current b. What current can be used for c. Construct thermocouple with a Wheatstone bridge and show how instrument can be made
G. Application.	1. Application. a. Sketch three methods of heating water; use proper symbols b. Sketch system using proper symbols; use altitude gauge, thermometer, pressure gauge and radiators c. Produce model system	

TO BE DEVELOPED

MATH	*COMMUNICATIONS*	*SOCIAL STUDIES*
1. Measure current produced by thermocouple.	1. Present forms for citing bibliographical references. 2. Assigned research of a great name in plumbing history. Require bibliography of six references. The references must be indexed by library catalog call number as well as author.	1. Effect upon public welfare. a. Industries b. Other trades c. Plumbing

III. APPLICATION

A. Provided for within the context of the lesson.

IV. EVALUATION CRITERIA GUIDELINE

A. Study carefully the sketches submitted; assure the proper system and symbols have been utilized.

B. The model system constructed by the student should be accurate and neat.

C. A mercury generator is _______.

D. An expansion tank is used to _______.

E. An artificial water line is _______.

F. The improper use of ties will result in _______.

G. Give two reasons this type of system is more economical.

H. What are the special ventilation requirements for schools?

I. What is an anemometer used for?

J. What is a pyrometer used for?

V. SUMMARY

A. The study of the hot water system has enlightened you as to its economical values and other values. With the knowledge of all the systems you will now be able to make a proper and wise choice of system for any given installation.

VI. SUGGESTED TIME AND SEQUENCE LISTING

30 minutes -- Film, introduction, screening and discussion

195 minutes -- Laboratory experiences

115 minutes -- Integrated curriculum concepts

20 minutes -- Summary and evaluation

VII. SUPPLEMENTAL REFERENCES AND RESOURCE MATERIAL

1) Eisinger, L. (Ed.), Handyman's Plumbing and Heating Guide, New York: Arco Publishing Company, Inc., 1955.

2) Lewis, Samuel R., *Sizing Pipes for Plumbers*, Scranton, Pa.: International Textbook Company, no date.

3) Starbuck, Robert M., *Modern Heating Illustrated*, Hartford, Conn.: R. M. Starbuck & Sons, Inc., no date.

4) Starbuck, Robert M., *Practice and Theory of Radiant Heating*, Hartford, Conn.: R. M. Starbuck & Sons, Inc., no date.

5) Starbuck, Robert M., *Questions and Answers on the Practice and Theory of Steam and Hot Water Heating*, Hartford, Conn.: R. M. Starbuck & Sons, Inc., no date.

INSTRUCTOR'S UNIT PLAN

Unit 14
Lesson 1
Time 6 Hours

CLUSTER: CONSTRUCTION

DIVISION: PLUMBING

SUBJECT: Selection and Installation of Fire Lines

AIM:

To have the student become knowledgeable in the area of fire fighting equipment installation. He should gain the background in both manually operated systems and automatic systems.

INSTRUCTIONAL AIDS:

Film - Inspection, Maintenance and Operation of Automatic Sprinkler Systems, Washington, D. C.: Norwood Films, 926 New Jersey Avenue, N. W. (16 mm, 25 minutes).

Model of dry and wet stand pipe systems.

EQUIPMENT:

Tools and equipment necessary to construct model systems.

16 mm projector and screen.

Assorted valves and sprinkler heads for display and discussion.

PRIMARY REFERENCES:

1) Matthias, A. J., Jr. et al., How to Design and Install Plumbing, Chicago: American Technical Society, 1968.

2) Slater, Harry, Plumbing, Related Information 1, Albany, New York: Delmar Publishers, Inc., 1958.

I. INTRODUCTION AND MOTIVATION

A. Introduce, screen and discuss film. Lead discussion into need for fire protection from which wet standpipe and dry standpipe installations are overviewed in addition to the sprinkler system shown in the film.

II. PRESENTATION OF INTEGRATED CONCEPTS

		RELATED CONCEPTS
INSTRUCTIONAL TOPICS	TECHNICAL CONCEPTS	SCIENCE
A. Fire line.	1. Installation types. a. Wet standpipe b. Wet standpipe with siamese connection c. Automatic system d. Dry standpipe study (no longer installed but should be aware of the system)	1. Metal structure. a. Bimetallic action when strips are connected together 1) Chemical reaction based on chemical activity 2) Differential expansion of metals b. Melting point of metals c. Compounds of metals that cause melting temperature to change
B. Installation wet standpipe.	1. Connection. a. Direct to building water system b. No siamese connection which is a disadvantage c. Drip on riser d. Standpipe vertical in building e. Hose cabinet connections 1) Height 2) Number required 3) Hose installation and type f. Gate valves 1) Main system 2) Cabinet g. Hose tests	1. Spontaneous combustion. a. Its cause b. How to prevent it c. Experiment to obtain
C. Installation wet standpipe with siamese connection.	1. Connections. a. Direct to building water supply b. Fire department can add water and pressure c. Possible domestic water supply contaminating by fire department choice of additional water d. Proper installation to prevent cross connection and water pollution	1. Quenching effectiveness of fire retardants. a. CO_2 b. Foam c. Water d. Wet chemicals e. Dry chemicals f. Fire by classes 1) Demonstration 2) Experimentation g. What does the retardant/controlling agent actually do
D. Automatic systems.	1. Installation. a. How it operates b. Determining size c. Controls d. Installation of pipes and heads 1) Proper spacing 2) Reducing pipe size for proper feed	1. Smoke effects. a. Human b. Fire c. Products d. Demonstrate the destructive distillation of wood and coal e. Examine products of distillation

TO BE DEVELOPED

MATH	COMMUNICATIONS	SOCIAL STUDIES
1. Pressures. a. Line of liquid transfer b. Pressure required to force a column of liquid to move (varying heights)	1. Basic skill drill. a. Spelling b. Punctuation c. Sentence structure d. Vocabulary of the trade 2. Library research to develop a list of fiction and nonfiction materials concerning fire fighting. 3. Select and read something from this list.	1. City fire-fighting systems. a. Personnel b. Equipment c. Alarm methods d. Liquid supply systems 2. Establishment of community fire laws for fire prevention.
1. Use of protractor. a. Advance, offset and travel of fittings angle b. Determination of proper wye or elbow to use c. Visual estimation of angle sizes	1. Pages for notebook. a. Description of fire-fighting systems; selection of the most desirable for each installation 1) Single story 2) Over 75' in height 3) Out of city 2. Report to class on outside reading.	1. Industry: a. Furnishing hose b. Furnishing trucks, ladders and hardware c. Furnishing pumps and related equipment
1. Rounding of numbers. (Work to the closeness required for the trade.)	1. Research and planning of a sales program to sell: a. A specific type of fusible head b. A specific product for a specific class of fire	1. Salable item. a. Fusible head 1) Design 2) Production consideration 3) Production line station arrangement 4) Limited trial run
1. Practical problems. a. 22-1/2° singles 22-1/2° parallels b. 45° singles 45° parallels c. 60° singles 60° parallels	1. Research and report of the local codes as pertains to the installation of fire-fighting systems in public buildings. 2. Small groups to survey and report on fire-fighting systems within various areas of the institution.	1. Fire-fighting methods. a. Forest b. Large building c. Small building

II. PRESENTATION OF INTEGRATED CONCEPTS

		RELATED CONCEPTS
INSTRUCTIONAL TOPICS	*TECHNICAL CONCEPTS*	*SCIENCE*
E. General.	1. General details. a. Valve tagging b. Color code c. Hose and nozzles d. Proper standpipe e. Privately-owned and maintained systems 1) Overhead storage 2) Pumping systems	1. Methods of distribution of retardants. a. Direct heavy pressure b. Fog c. Demonstration
F. Application.	1. Construction of model system. a. Design b. Construct model wet standpipe system for a story building	

TO BE DEVELOPED

MATH	COMMUNICATIONS	SOCIAL STUDIES
1. Construct a table of make-up allowances for 1/2", 1", 1-1/2", 2", 3", and 4". a. Standard cast and malleable b. DWV copper c. Cast iron drainage	1. Letter to an insurance company requesting data on fires in the U. S., their causes and the best methods of future prevention. Report by appointed individuals upon the returned data.	1. Insurance. a. Study of companies 1) How rates are determined 2) Investigation to determine application of rate scales

C-III-14.7

III. APPLICATION

A. Provided within the body of the lesson.

IV. EVALUATION CRITERIA GUIDELINE

A. Close evaluation of the model to determine if the system could operate properly.

B. The dry standpipe fire system depends upon _______ for its operation.

C. Does an automatic fire protection system ever need assistance from the fire department? Explain.

D. Can water system pollution ever occur from any of the systems discussed? Explain.

E. Explain a siamese connection.

V. SUMMARY

A. Review the types of fire systems--their advantages and disadvantages. Have one or two students explain how the dry standpipe and wet standpipe fire systems compare or differ in installation and operation.

VI. SUGGESTED TIME AND SEQUENCE LISTING

45 minutes -- Introduce, screen and discuss film. Motivation step

180 minutes -- Laboratory experience

115 minutes -- Integrated curriculum concepts

20 minutes -- Summary and evaluation

VII. SUPPLEMENTAL REFERENCES AND RESOURCE MATERIAL

1) Dibble, Samuel Edward, Elements of Plumbing, New York: McGraw-Hill Book Company, no date.

2) Levis, Samuel R., Sizing Pipes for Plumbers, Scranton, Pa.: International Textbook Company, no date.

3) Local Fire Protection Codes for buildings.

4) Oravetz, Jules, Plumbers and Pipe Fitters Library, Indianapolis: Theodore Audel, 1967.

INSTRUCTOR'S UNIT PLAN

Unit 15
Lesson 1
Time 6 Hours

CLUSTER: CONSTRUCTION

DIVISION: PLUMBING

SUBJECT: Leadwork and Flanges

AIM:

To develop the background and ability of the student to make satisfactory lead joints and roof flanges from lead as well as other materials.

INSTRUCTIONAL AIDS:

Film - A Story of Lead, Pittsburgh, Pa.: Bureau of Mines, Central Experiment Station, 4800 Forbes Avenue, Attention Mr. Reiners (16 mm, 22 minutes).

Film - Lead from Mine to Metal, Pittsburgh, Pa.: Bureau of Mines, Central Experiment Station, 4800 Forbes Avenue, Attention Mr. Reiners (16 mm, 28 minutes).

Examples of work.

EQUIPMENT:

16 mm projector and screen.

Pipe and equipment needed by the students while making joints and flanges in the application step.

PRIMARY REFERENCES:

1) Manly, Harold P., Plumbing Installation and Repair, Skokie, Ill.: F. J. Drake & Company, no date.

2) Matthias, A. J., Jr. et al., How to Design and Install Plumbing, Chicago: American Technical Society, 1968.

3) Slater, Harry, Plumbing, Related Information 1, Albany, New York: Delmar Publishers, Inc., 1958.

I. INTRODUCTION AND MOTIVATION

A. Introduce, show and discuss film. (Students should be encouraged to discuss this different way of directing waste materials.) The use of lead is a very old way of accomplishing plumbing. It takes a little more practice than does the threading of pipe.

II. PRESENTATION OF INTEGRATED CONCEPTS

		RELATED CONCEPTS
INSTRUCTIONAL TOPICS	TECHNICAL CONCEPTS	SCIENCE
A. Leadworking.	1. Leadworking tools. a. Soldering bits 1) Straight 2) Hatchet b. Turn pin c. Tap borer d. Shave hook e. Bending iron f. Dresser g. Drift plug h. Pipe benders i. Dividers j. Lead pipe clamps	1. Make solder. a. Vary content of tin test melting point, strength factors b. Make a graph to illustrate how change in alloy changes melting point and strength c. Discuss specific heat d. Describe crystalline structure e. Caution on hazards of lead poisoning
B. Leadwork.	1. Demonstration. a. How to make a cup joint 1) Drifting lead 2) Feeding solder b. How to make a flat roof flange 1) Flat roof flange 2) Estimating diameter c. How to make a pitched roof flange 1) Templet use 2) Layout d. How to wipe a lead joint 1) Wiping 1" to 1-1/2" lead to 1" to 1-1/2" lead joint 2) Wiping a 2" lead to a 4" lead wye joint 3) Wiping a lead to a brass joint	1. Fluxes. a. Reason for flux b. Materials used for flux c. Specialized application for each flux d. Allow flux to remain on metal pieces that have been soldered. Record result at a later date.
C. Tools.	1. Maintenance. a. Care and handling b. Sharpening c. Adjustment and repair d. Lubrication	1. Cultures. a. Finalize experiment of light-dark on growth of bacteria
D. Application.	1. Projects. a. Make a cup joint b. Make a flat roof flange c. Make a pitched roof flange d. Wipe a lead to lead 1) Same size 2) Small to large size 3) Lead to brass and/or other materials	1. Experiment. a. Using acids, attempt to find one that attacks lead b. Study of other acid-resisting metals c. Further study of alloying of metals and their usefulness

TO BE DEVELOPED

MATH	COMMUNICATIONS	SOCIAL STUDIES
1. Resistance to crushing. a. Square b. Rectangle c. Pipe (This should be actual experiences within the classroom using hydraulic or manual equipment to attempt or actually crush the pipe)	1. Basic skill practices. a. Spelling b. Punctuation c. Paragraphing	1. Use of lead by ancient civilizations. 2. Origin of the word "plumber." 3. Location of deposits of lead in the United States.
1. Other experiment variables. a. Wall thickness b. Pipe diameter (square side or rectangle) increase c. Change in material d. Type of crushing experienced	1. Page in booklet. a. Explain the process of lead wiping a joint b. Explain how making a roof flange does not differ even though different metals are utilized	1. Use of tin by ancient civilizations. 2. Location of deposits of tin in the world. a. Percent imported from each area b. Utilization of tin by other industries than the making of lead
1. All above experiment results recorded in graph form. Using experiment factors.	1. Write to a solder manufacturing company requesting information covering the total manufacturing process from mine to consumer. 2. Library research to confirm the information and discover additional sources.	1. Trace one pound of lead from the mine to the melting point use of the individual.
1. Collapse due to bending. a. Angle b. Effect of shape c. Effect of size d. Comparative graph of the results	1. Oral presentation of the advantages/disadvantages of the use of lead over other possible choice of materials for several dissimilar jobs.	1. Trace difference between industry that makes lead for the plumbing trade and industry that makes "lead" for pencils.

III. APPLICATION

A. Provided for within the body of the lesson.

IV. EVALUATION CRITERIA GUIDELINE

A. Close attention should be directed toward the workmanship of the joints and flanges made during the application step.

B. _______ is added to lead to make solder.

C. A turn pin is _______.

D. Can lead and brass be joined? Explain.

E. List the steps necessary for making a flat roof flange.

V. SUMMARY

A. You have learned an interesting way of making joints as well as learning how to make flanges. Practice will improve your ability but only if you have the right attitude toward your workmanship.

VI. SUGGESTED TIME AND SEQUENCE LISTING

60 minutes -- Introduce, screen and discuss films

165 minutes -- Laboratory experiences

115 minutes -- Integrated curriculum concepts

20 minutes -- Summary and evaluation

VII. SUPPLEMENTAL REFERENCES AND RESOURCE MATERIAL

1) Dibble, Samuel Edward, Elements of Plumbing, New York: McGraw-Hill Book Company, no date.

2) Oravetz, Jules, Plumbers and Pipe Fitters Library, Indianapolis: Theodore Audel, 1967.

3) Local codes covering materials and installation procedures.

INSTRUCTOR'S UNIT PLAN

Unit 16
Lesson 1
Time 6 Hours

CLUSTER: CONSTRUCTION

DIVISION: PLUMBING

SUBJECT: Transits

AIM:

To have the student become capable of proper use of the transit. The lesson will also instruct the student in the proper method of marking work areas for the work that is to be accomplished.

INSTRUCTIONAL AIDS:

Transit set.

Manuals on use and operation of transits.

Film - Transit Traverse for Topographic Mapping, Washington, D. C.: U. S. Geological Survey, Information Office (16 mm, 25 minutes).

Film - Triangulation for Topographic Mapping, Washington, D. C.: U. S. Geological Survey, Information Office (16 mm, 30 minutes).

EQUIPMENT:

Hammers, rope, nails and boards for batten boards, stakes, cloth streamers and marking materials for staking out trenches.

Trench digging equipment.

PRIMARY REFERENCES:

1) Brinker, Russell C. and Taylor, W. C., Elementary Surveying, Scranton, Pa.: International Textbook Company, 4th Edition, no date.

2) Plumbing Apprentice and Journeyman Training, Chapter B-5, Washington, D. C.: Joint Apprentice Text, Inc., Merkle Press, Inc, no date.

I. INTRODUCTION AND MOTIVATION

A. To be the best in the trade, one needs to know the complete trade, therefore, you should understand the transit, its use and how to mark the resultant findings for the person who is to do the work.

II. PRESENTATION OF INTEGRATED CONCEPTS

INSTRUCTIONAL TOPICS	TECHNICAL CONCEPTS	RELATED CONCEPTS SCIENCE
A. Location.	1. Use of transits. a. Nomenclature of the transit b. Nomenclature of the tripod c. How it is assembled	1. Gravity. a. Define b. Measurement of matter, energy and work c. Use of machines to accomplish work d. Calculate work accomplished in everyday tasks
B. Scales.	1. Use of scales. a. Horizontal b. Vertical c. How to establish a level line d. Degrees of turning e. How to establish a line other than level f. How to lay out a trench	1. Friction. a. Working for us b. Working against us c. Cite everyday exposure to the use of friction d. Friction as a factor affecting efficiency
C. Trade practices.	1. Trenches. a. Batten boards b. Cut marks c. Use of transit during excavation	1. Lubricants. a. Definition b. Source c. Use d. Problems and dangers e. How they reduce friction

TO BE DEVELOPED

MATH	COMMUNICATIONS	SOCIAL STUDIES
1. Computation of pipe lengths. a. Offset 90° b. Offset other than 90°	1. Study of journalism. a. Outstanding persons b. Importance of excellent and free press c. Effects contributed to society by having a free press 2. Report on the influence of John Peter Zenger. 3. Review current attitudes toward the press by government officials and certain minority groups. 4. Study the communication systems operating within the institution and make suggestion for changes. 5. Explore the possibilities of developing and publishing a one-page weekly newsletter.	1. History of newspapers. a. Early civilizations b. Invention of printing from movable type c. Early U. S. newspapers d. Zenger case 2. Comparative study. a. Countries with good news coverage and those with little news coverage 1) Development of culture 2) Enlightened population capable of self-direction 3) Effect upon consumer purchasing habits
1. Construct tables of constants for travel, advance and offset for 5-5/8°, 11-1/4°, 22-1/2°, 30°, 45°, 60°, and 72°.	1. How a newspaper magazine is published. a. Collection of items b. Make-up of dummies c. Get-ready stage d. Printing e. Transportation to sales outlets f. Subscription-sales procedures g. Consumer outlet (Use trade publications as basis of study)	1. Occupational study. a. Number of related occupations affected by publications b. Number of occupations affected that are not directly related to publication c. Technology advancement within the occupation in countries with small and large publishing facilities
1. Additive take-off problems.	1. Notebook. a. Page on proper use of transit b. How to stake out an area so the work crew can do a proper job of trenching	1. Comparative relationship. a. Direct relationship between news publication and sanitary facilities b. Percent of publication employees compared with those in plumbing employ

II. PRESENTATION OF INTEGRATED CONCEPTS

		RELATED CONCEPTS
INSTRUCTIONAL TOPICS	***TECHNICAL CONCEPTS***	***SCIENCE***
D. Application.	1. Transit practice. a. Use to establish a level line b. Use to establish an angle line c. Use to locate a specific point from drawings d. Use to establish slope of trench for soil pipe run 1) With level ground 2) With slope ground 3) With uneven topography 4) During above student will utilize batten boards and other trade related practices	1. Vectors. a. Acceleration involving vectors b. Deceleration involving vectors c. Resultants upon the human body of rapid change d. Effect due to position 2. Acceleration due to gravity. a. Effect within vacuum b. Effect in normal atmosphere c. Application to everyday items--basis for discussion of need for energy--multiplying equipment

TO BE DEVELOPED

MATH	COMMUNICATIONS	SOCIAL STUDIES
1. Practical problems for determining advance, travel and offset length of needed pipe. 2. Student to draw scale drawing of typical drainage system.		

III. APPLICATION

A. Provided within the body of the lesson.

IV. EVALUATION CRITERIA GUIDELINE

A. The student will be evaluated by his ability to properly locate points and mark them for the work that is to be accomplished. The proper installation of batten boards is also an evaluation point.

V. SUMMARY

A. Your use of the transit has prepared you in two ways to be a better workman. First, you have learned how to use the transit and mark the work that is required. Second, you can read the work that must be done from the surveyor's markings.

VI. SUGGESTED TIME AND SEQUENCE LISTING

15 minutes -- Overview and introduction

210 minutes -- Laboratory experiences--surveying and marking

115 minutes -- Integrated curriculum concepts

20 minutes -- Summary review of evaluation

VII. SUPPLEMENTAL REFERENCES AND RESOURCE MATERIAL

1) Babbitt, Harold E., Plumbing, New York: McGraw-Hill Book Company, 1960, 3rd Edition.

2) Davis, Raymond E. et al., Surveying: Theory and Practice, New York: McGraw-Hill Book Company, 5th Edition, no date.

3) Oravetz, Jules, Plumbers and Pipe Fitters Library, Indianapolis: Theodore Audel, 1967.

4) Parker, Harry E., Simplified Engineering for Architects and Builders, New York: John Wiley & Sons, Inc., 1967, 4th Edition.

INSTRUCTOR'S UNIT PLAN

Unit 17
Lesson 1
Time 6 Hours

CLUSTER: CONSTRUCTION

DIVISION: PLUMBING

SUBJECT: On-the-Job Work Aids

AIM:

To have the student gain a knowledge of an ability to utilize the many aids that are available to him to ease his job. The student should be able to use each item, in the classroom atmosphere, so he will be capable of rapid and proper selection when faced with a problem on the job site.

INSTRUCTIONAL AIDS:

Items to be utilized within the body of the lesson. These will be displayed and explained.

EQUIPMENT:

Block and tackle, ropes and slings, portable hoist, scaffolding, ladders, propane torches, Prestolite torches, gas and air torches, gasoline torches, bench vises, pipe vises, pipe reamers, seat dressers, stock and dies, pipe tap and dies, closet augers and sewer augers.

PRIMARY REFERENCES:

1) Manly, Harold P., Plumbing Installation and Repair, Skokie, Ill.: F. J. Drake & Company, no date.

2) Matthias, A. J., Jr. et al., How to Design and Install Plumbing, Chicago: American Technical Society, 1968.

3) Oravetz, Jules, Plumbers and Pipe Fitters Library, Indianapolis: Theodore Audel, 1967.

I. INTRODUCTION AND MOTIVATION

A. There are many ways to use equipment--some safe, others not. This lesson is to instruct you in the proper methods of use for many different types of equipment you need to accomplish your work.

II. PRESENTATION OF INTEGRATED CONCEPTS

		RELATED CONCEPTS
INSTRUCTIONAL TOPICS	***TECHNICAL CONCEPTS***	***SCIENCE***
A. Necessary supporting equipment.	1. Work requirement aids. a. Block and tackle b. Ropes and slings c. Portable hoist d. Scaffolding e. Ladders f. Propane torches g. Prestolite torches h. Gas and air torches i. Gasoline torches j. Bench vises k. Pipe vises l. Pipe reamers m. Seat dressers n. Stock and dies 1/8"-4" and pipe tap and dies o. Closet augers p. Sewer augers	1. Biodegradable chemicals: a. Identification b. Utilization c. Meaning d. How accomplished
B. Application.	1. Student application: Each student will be required to perform an assigned task involving each of the above items. The task should be a realistic application involving mock-ups that would present duplicate problems of those known to exist in the field.	1. Effect. a. Metals b. Plastics c. When mixed with other chemicals d. Environmental
C. Science aspects.		1. Comparative analysis. a. With detergents studied in prior lessons b. Animal-human extractions c. Effect of each upon metals--materials commonly utilized by the plumbing trades
D. Architecture		

TO BE DEVELOPED

MATH	COMMUNICATIONS	SOCIAL STUDIES
1. Problems of practical application to determine pipe length. a. Straight line lengths b. Involving single angles c. Involving dual angles--no straight line d. Involving dual angles with straight line e. Around existing plumbing such as would occur in remodeling f. Involving installation of multiple units to a single waste line g. Multiple outlets from single line in a wall with back-to-back lavatories and commodes	1. Basic skill drill. a. Reading b. Spelling c. Punctuation	1. Field trip: Include building of age and a modern building. These should be studied for their differences as to installation of equipment and utilization of space. Comparison of materials utilized as well as their installation should be studied.
1. Fractional part measurement and conversion review.	1. Notebook pages. a. Safety to be exercised in use of flame devices when used in structures b. Safety to be exercised when on equipment such as ladders and scaffolding c. Paragraph per item on use of items listed under Work Requirement Aids	1. Architecture. a. Modern over old b. Improvements from the architect through the plumbing trade
	1. Report, oral, on the author, Robert M. Starbuck.	1. Health improvement factors resulting from the changes that have occurred.
		1. History of architecture. a. Styles b. American architecture 1) 20th century skyscraper 2) "Modern" 3) Frank Lloyd Wright and others

III. APPLICATION

A. Provided for within the body of the lesson.

IV. EVALUATION CRITERIA GUIDELINE

A. The student's ability to safely and properly make use of the equipment is the fundamental requirement of this lesson. Each of the pieces of equipment should be utilized by each individual and his use of it be the basis for his evaluation.

V. SUMMARY

A. Safe working habits are an absolute necessity. Your exposure to this equipment has introduced you to many possible hazards that can be brought about by carelessness. At all times, be very careful of the equipment condition and the safety of the method in which it is utilized.

VI. SUGGESTED TIME AND SEQUENCE LISTING

15 minutes -- Introduction and motivation

210 minutes -- Laboratory experiences

115 minutes -- Integrated curriculum concepts

20 minutes -- Summary and evaluation discussion

VII. SUPPLEMENTAL REFERENCES AND RESOURCE MATERIAL

1) Dibble, Samuel Edward, Elements of Plumbing, New York: McGraw-Hill Book Company, no date.

2) Graham, Frank and Emery, T. J., Plumbers and Steam Fitters Guides, Indianapolis: Theodore Audel, no date.

3) William, Robert, Plumbing Handbook, Washington, D. C.: U. S. Printing Office, Federal Board for Vocational Education, Bulletin No. 200, Superintendent of Documents, no date.

INSTRUCTOR'S UNIT PLAN

Unit 18
Lesson 1
Time 6 Hours

CLUSTER: CONSTRUCTION

DIVISION: PLUMBING

SUBJECT: Private Disposal Systems

AIM:

The student should be capable of accomplishing any of the many facets of plumbing. The designing and installing of a private disposal system is one of the complex operations the student should completely understand so that he can do a satisfactory installation when called upon to do so.

INSTRUCTIONAL AIDS:

Models of septic tanks and drain fields.

Film - Watershed Conservation, Washington, D. C.: Bureau of Land Management, U. S. Department of the Interior (16 mm, 11 minutes).

Film - Water: Wealth or Worry for America, New York: Modern Talking Picture Service, 1212 Avenue of the Americas (16 mm, 24 minutes).

EQUIPMENT:

16 mm projector and screen.

Digging equipment, necessary materials for construction of septic tank and drain (leech) field.

PRIMARY REFERENCES:

1) Matthias, A. J., Jr. et al., How to Design and Install Plumbing, Chicago: American Technical Society, 1968.

2) Slater, Harry, Plumbing, Related Information 1, Albany, New York: Delmar Publishers, Inc., 1958.

3) Starbuck, Robert M., Sanitary Plumbing, Vol. III, Hartford, Conn.: R. M. Starbuck & Sons, Inc., 1954.

I. INTRODUCTION AND MOTIVATION

A. Introduce, screen and discuss films. This should be used to lead to a discussion of the problems of safe disposal of waste materials in the urban areas. The discussion should include the dangers to people if incorrect procedures are utilized.

II. PRESENTATION OF INTEGRATED CONCEPTS

		RELATED CONCEPTS
INSTRUCTIONAL TOPICS	*TECHNICAL CONCEPTS*	*SCIENCE*
A. Private disposal systems.	1. Types. a. Septic tank b. Cesspool c. Privy d. Necessary drain fields	1. Chemical effect upon materials (as used by plumbers). a. Commercial soil applications b. Natural soil ingredients c. In wet soil d. In dry soil
B. Computation.	1. Basis for determining size of necessary facility. a. Per user b. Based on extra equipment use c. Settling and overflow side of septic d. Earth absorption rate for cesspools	1. Air pollution effects. a. Rural b. Urban c. Deterioration preventative measures 2. Water pollution effects. a. Chemical contamination b. Effect on potability c. Dilution rates d. Accumulation rates
C. Liquid overflow.	1. Field requirements. a. Local codes b. Requirements of usage c. Effect of depth d. Materials utilized for field, tank or pool lining e. Earth absorption rate effect on field	1. Seepage rates. a. Clay b. Sand c. Rock
D. Venting.	1. Venting requirements. a. Tank b. Cesspool c. Field d. Feed to tank or cesspool	1. Filtering effects. a. Clay b. Sand c. Rock
E. Access.	1. Access opening. a. Local code b. Construction methods c. Why required	1. Saturation point a. Clay b. Sand c. Rock
F. Application.	1. Application. a. Each student will 1) Compute requirements for a four member family with automatic washing machine a) Septic tank b) Cesspool 2) Field for each b. Group will compute, build and install septic tank and the related field	1. Experiments with appropriate materials and chemicals.

TO BE DEVELOPED

MATH	COMMUNICATIONS	SOCIAL STUDIES
1. Working to tolerances. a. Straight line b. One elbow and line c. Two elbows and line	1. Basic language skills. a. Spelling b. Punctuation c. Paragraphing	1. Relief map of rural area strata. a. Top soil b. Other layers c. Water strata d. Small creek or river e. Drilled well for water supply
1. Wall-to-wall fittings. a. One wall-to-fixture b. Back-to-back fixtures in a single wall c. Fixtures on two walls d. Emphasize need for accurate measurement	1. Page for notebook. a. Septic tank care b. Problems connected with septic tanks and fields c. Bacteria addition	1. Using relief map. a. Show septic tank and field installation b. Study the seepage effect from the installation c. Study possible pollution factors d. Study of how the health of many can be endangered
1. Computations. a. Cubic foot b. Cubic yard c. Cost of movement d. Cost for trenching by footage or yardage		1. Downstream or hill considerations. a. Rural (farm) soil surface runoff b. Rural (farm) waste products (animal as well as human) can add pollution c. Preventative measures for surface and subsurface runoff
1. Graph for computation of septic tank requirements. a. Per individual vs. suggested cubic foot requirement of tank b. Per individual vs. suggested feet of field		1. Map usage (relief map)

III. APPLICATION

A. Provided in the body of the lesson.

IV. EVALUATION CRITERIA GUIDELINE

A. Septic tank size is determined by _______.

B. Waste within the septic tank is reduced to liquid by _______.

C. The size of the leech field is determined by _______.

D. The materials utilized to make a drainage field are _______.

E. Close attention should be paid to individual effort and workmanship during the construction of the septic tank and the drain field. Evaluation of the individual workmanship should represent about 50% of the total evaluation.

V. SUMMARY

A. It has been shown how the public health and environment can be protected by thought and careful workmanship. Whenever you plan a job, you should remember the total effect of your work. In all cases, thoughtfulness on your part can insure protection of nature as well as individuals.

VI. SUGGESTED TIME AND SEQUENCE LISTING

45 minutes -- Introduce and show film

180 minutes -- Laboratory experience

115 minutes -- Integrated curriculum concepts

20 minutes -- Summary and evaluation

VII. SUPPLEMENTAL REFERENCES AND RESOURCE MATERIAL

1) Plumbing, Washington, D. C.: U. S. Public Health Service Division of Environment Engineering and Food Protection, Public Health Service Publication, No. 957, no date.

2) Wright, Forrest B., Rural Water Supply and Sanitation, New York: John Wiley & Sons, Inc., 1956, 2nd Edition.

3) Periodical: Master Plumber and Heating Contractor, The Master Plumber, Brooklyn, New York, no date.

INSTRUCTOR'S UNIT PLAN

Unit 19
Lesson 1
Time 6 Hours

CLUSTER: CONSTRUCTION

DIVISION: PLUMBING

SUBJECT: Railing Work, Repair, and Storm Disposal Systems

AIM:

To develop within the student the knowledge necessary to accomplish the several skills needed to successfully complete railing work, the repair of systems and the design and installation of storm disposal systems.

INSTRUCTIONAL AIDS:

Samples of railing installations (models).

Clean-out equipment for the systems outlined in B of the lesson.

A rain (storm) disposal system model for a typical small home and a commercial building.

Film - Loop and Circuit Venting the Plumbing System, Columbus, Ohio: Ohio State University, Motion Picture Division, Townsend Hall, Room 113, 1885 Neil Avenue, Attention William A. Drake (16 mm, 14 minutes).

EQUIPMENT:

16 mm projector and screen.

Equipment and materials necessary to properly accomplish Step F.

PRIMARY REFERENCES:

1) Matthias, A. J., Jr. et al., How to Design and Install Plumbing, Chicago: American Technical Society, 1968.

2) Slater, Harry, Plumbing, Related Information 1, Albany, New York: Delmar Publishers, Inc., 1958.

3) Starbuck, Robert M., Sanitary Plumbing, Vol. III, Hartford, Conn.: R. M. Starbuck & Sons, Inc., 1954.

I. INTRODUCTION AND MOTIVATION

A. Introduce, screen and discuss film. Since venting is so necessary and must be clean, then the system must also be clean. Explain need for clean full flow system. Ask questions about railing installations and develop the need for the knowledge. Investigate reasons for the need for storm drains in homes as well as commercial buildings.

II. PRESENTATION OF INTEGRATED CONCEPTS

	RELATED CONCEPTS	
INSTRUCTIONAL TOPICS	*TECHNICAL CONCEPTS*	*SCIENCE*
A. Railing work.	1. Operations. a. How to install railing b. Types of anchors c. Fittings and fabrication	1. Expansion-contraction. a. Result of subject to cold for: 1) Metals 2) Plastics 3) Ceramics b. Result of subject to heat for: 1) Metals 2) Plastics 3) Ceramics
B. Repair work.	1. Operations. a. Cleaning out 1) Clogged sewer in a basin 2) Clogged sewer in a sink 3) Branches of a system 4) Main house drain b. Repair of a faucet c. Repair of a tank water closet d. Repair of a flushometer e. Repair of a cold water system f. Repair of a hot water system g. Review of analyzing a plumbing problem	1. Practical. a. Measurement b. Heat-freeze fittings 2. Expansion profile of freezing water. a. Danger of pipe damage b. Precautions
C. Rain disposal systems.	1. Construction and installation. a. Installation of storm drain 1) Inside 2) Outside 3) Overhead b. Drain 1) Sizing 2) Terminal 3) Roof leaders c. Correlation of drainage system as a whole	1. BTU heat source to prevent freezing (minimum). a. Storm installation b. Why necessary 1) Excessive ice damage 2) Excessive snow damage
D. Protection.	1. All systems protection. a. Against freezing b. Against mechanical damage	1. Earth movement under freezing conditions. a. Depth b. Movement effect c. Ecology effect

TO BE DEVELOPED

MATH	*COMMUNICATIONS*	*SOCIAL STUDIES*
1. Triangle figures. a. T, A and O figures for installation of: 1) Single fixture 2) Dual fixture 3) Multiple installation	1. Basic language arts skills.	1. Foreign waterways, rivers. a. Cities that border them b. Disposal into rivers c. Compare between U. S. and foreign waterways 2. Map usage (political maps)
1. Material. a. Pricing from listings b. Weights for transportation costs c. Transportation costs based on weights d. Lists based on drawings and specification sheets 2. BTU's a. Define b. Students calculate typical BTU ratings	1. Reading of classic literature. a. Shakespeare 1) Development of literature and the time depicted 2) Relationship as to heating and plumbing of era b. Other authors using steps 1 and 2 of above	1. Ocean front. a. Cities that border b. Disposal into c. Compare between U. S. and foreign rate of pollution
1. Labor cost. a. Man-hour b. Cost per man-hour c. Bill from known man-hour of work d. Estimates of man-hours from drawings and specifications	1. Page for notebook. a. Reason for storm drain b. Description of installation c. Heating requirements and why heating is necessary	1. Ocean ability to absorb. a. Present b. Projected c. Can ocean reduce waste disposal in it and continue to be polluted
1. Basic mathematical drill.	1. Use of catalogs. a. Library b. Materials c. Tools d. Instructional aids	1. Erosion. a. Why b. River saturation point of ability to transport c. Delta effect d. Projected effect of waterways from erosion and pollution e. Soil Conservation Service established 1935 as a result of the "dust bowl"

II. PRESENTATION OF INTEGRATED CONCEPTS

RELATED CONCEPTS

INSTRUCTIONAL TOPICS	TECHNICAL CONCEPTS	SCIENCE
E. Cross-connections.	1. Scientific aspects. a. Cross-connections in plumbing fixtures b. Reference to local code	
F. Application.	1. Students will: a. Install an assigned railing b. Accomplish repair of each of the items listed in B using item g as a basis for the repair c. Design and install on a model module a storm drain system	

TO BE DEVELOPED

MATH	COMMUNICATIONS	SOCIAL STUDIES
	1. As journeymen. a. Oral presentation of how they will help instruct apprentice helpers in the requirements of the trade b. Written presentation of a	

III. APPLICATION

A. Provided for within the body of the lesson.

IV. EVALUATION CRITERIA GUIDELINE

A. The student's workman-like attitude and professional approach to the assigned problems will be the basic evaluation tool.

V. SUMMARY

A. This lesson has instructed you in the proper approaches to the remedy of problems. Many problems were displayed, solved and discussed, but they are only a part of the many you will encounter. Remember to use the step-by-step problem solving approach and the problems will be easy to solve and work around.

VI. SUGGESTED TIME AND SEQUENCE LISTING

45 minutes -- Film and motivation procedures

180 minutes -- Laboratory experiences

115 minutes -- Integrated curriculum concepts

20 minutes -- Summary and evaluation

VII. SUPPLEMENTAL REFERENCES AND RESOURCE MATERIAL

1) Dibble, Samuel Edward, Elements of Plumbing, New York: McGraw-Hill Book Company, no date.

2) Graham, Frank and Emery, T. J., Plumbers and Steam Fitters Guides, Indianapolis: Theodore Audel, no date.

3) William, Robert, Plumbing Handbook, Washington, D. C.: U. S. Printing Office, Federal Board for Vocational Education, Bulletin No. 200, Superintendent of Documents, no date.

INSTRUCTOR'S UNIT PLAN

Unit 20
Lesson 1
Time 6 Hours

CLUSTER: CONSTRUCTION

DIVISION: PLUMBING

SUBJECT: Personal Health and Safety

AIM:

The student is to develop an understanding of the problem of personal safety. The student will be allowed to demonstrate the learning that has taken place through the construction of a model project.

INSTRUCTIONAL AIDS:

Film - Lifting, Man's Age Old Problem, Hartford, Conn.: Aetna Life & Casualty, Public Relations and Advertising Department, Film Library, 151 Farmington Avenue (16 mm, 14 minutes).

Film - Facts About Backs, Bell System Telephone Offices (Contact Local Business Office) (16 mm, 14 minutes).

Heating equipment (demonstration of dangers).

EQUIPMENT:

16 mm projector and screen.

Items necessary to accomplish B and C.

PRIMARY REFERENCES:

1) Matthias, A. J., Jr. et al., How to Design and Install Plumbing, Chicago: American Technical Society, 1968.

2) Slater, Harry, Plumbing, Related Information 1, Albany, New York: Delmar Publishers, Inc., 1958.

3) Starbuck, Robert M., Sanitary Plumbing, Vol. III, Hartford, Conn.: R. M. Starbuck & Sons, Inc., 1954.

I. INTRODUCTION AND MOTIVATION

A. Introduce, screen and discuss film. The film should be the basis for a discussion about the fact that only a safe, healthy person can work intelligently and effectively.

II. PRESENTATION OF INTEGRATED CONCEPTS

		RELATED CONCEPTS
INSTRUCTIONAL TOPICS	*TECHNICAL CONCEPTS*	*SCIENCE*
A. Personal health.	1. Identification. a. Lead 1) Can poison 2) Safe working habits a) Heating b) During use c) About closed space b. Galvanized 1) Cuts and when working with heat a) Zinc b) Under heat will put off poison c. Infections 1) What it is 2) How it can be obtained 3) Prevention d. Lifting 1) Muscles to use 2) Effect of incorrect use e. Burn hazards f. Small metal implantation problems g. First Aid instruction h. Safe working habits in shop and on the job for single and multiple storied buildings--especially in trenches	1. Metal coatings. a. Zinc (galvanized) b. Aluminum c. Copper d. How accomplished 1) Zinc 2) Aluminum 3) Copper e. Advantages f. Necessity of remaining intact--result of breaking through coating g. Accomplish each of the three processes represented by the choice of materials
B. Application - Safety	1. Student will demonstrate his knowledge of safe working habits by: a. Working with lead pipe joints and pouring of lead seal joints b. Working with galvanized being required to make a roof flashing and soldering as well as brazing it c. Lifting several objects to demonstrate his knowledge of the safe way of lifting so as to prevent injury to himself	1. Ability of each coating type to withstand chemical attack. a. Nitric acid bath b. Sulfuric acid c. Household chemicals 1) Detergents 2) Ammonia 3) Others

TO BE DEVELOPED

MATH	COMMUNICATIONS	SOCIAL STUDIES
1. Problems of T, O and A. a. Single story b. Multiple story c. Multiple story, multiple fixture installation	1. Basic language arts. a. Spelling b. Sentence structure c. Paragraphing 1) Idea sentence 2) Summary sentence	1. Soil freezing. a. Maps 1) Where 2) Frost line 3) How to use to prevent line damage 4) How to obtain local area information
1. Practical practice with transit. a. Layout of trench b. Location of foundation pierce point using transit c. Layout of lot that requires proper spacing of: 1) House for family of five 2) Septic system with field 3) Well water source Note: Lot is 200' x 200' and is flat. Subsoil is 3' clay, 1' shale, then 7' sand	1. Notebook page. a. Safety on the job 1) Lifting 2) Ventilation 3) Shoring when working in trenches b. Safety with materials and equipment 1) Poisoning and cutting 2) Burns 3) Falling	1. Effects of abnormal weather. a. Hurricane b. Typhoon c. High winds Note: These should be developed with the vent system in mind and its possible effect upon traps and water dislodging.

INSTRUCTIONAL TOPICS	TECHNICAL CONCEPTS	RELATED CONCEPTS
		SCIENCE
C. Application - Plastic systems	1. Practical demonstration. a. Will design multiple story system b. (Using plastic to gain a knowledge of its working characteristics) will construct the total system. The system will include roughing-in all the fixture outlets that would be installed in such a building as well as bathing (tub and shower) that may not be required should the student design a commercial type of building system. c. The system must be tested as liquid tight and properly vented so as to prevent pollution of the drinking and bathing water sources.	

III. APPLICATION

A. Provided for within the body of the lesson.

IV. EVALUATION CRITERIA GUIDELINE

A. The student will be evaluated based upon his model system. This practical application of a presented problem should determine if the individual requires additional aid in grasping the concepts required of the apprentice plumber.

V. SUMMARY

A. At this point, one can state you have been introduced to the basic requirements of the plumbing trade. Only through continued studies can you upgrade your knowledge and your position in the trade.

VI. SUGGESTED TIME AND SEQUENCE LISTING

45 minutes -- Introduction and motivation

180 minutes -- Laboratory experience

115 minutes -- Integrated curriculum concepts

20 minutes -- Summary and evaluation

VII. SUPPLEMENTAL REFERENCES AND RESOURCE MATERIAL

1) American Red Cross. Contact local representative for arrangement of First Aid Instruction Program.

2) Dibble, Samuel Edward, Elements of Plumbing, New York: McGraw-Hill Book Company, no date.

3) Graham, Frank and Emery, T. J., Plumbers and Steam Fitters Guides, Indianapolis: Theodore Audel, no date.

4) William, Robert, Plumbing Handbook, Washington, D. C.: U. S. Printing Office, Federal Board for Vocational Education, Bulletin No. 200, Superintendent of Documents, no date.

TO BE DEVELOPED

MATH	COMMUNICATIONS	SOCIAL STUDIES
1. Practical. a. Size of tank required in B (1 member requires 50 cubic feet of tank and 100 square feet of field) b. Size of field c. Total material in double chamber tank d. Total ceramic pipe required for field and lead to the house e. Gravel required f. Felt paper required g. Shoring required when working in trenches Note: Field and septic tank must remain so that 100' distance is maintained between the well casing and them.	1. Reports. a. Oral--How to instruct safety to apprentices. b. Written--How to instruct safety to apprentices c. How can the instruction presented during this course be improved? (Note: Item c should be nonidentifiable but counted to insure proper number)	1. Latest developments in improvement of urban area disposal plants. a. Government control b. Development of restrictions of dumping into waterways c. Investigation by class members into possible ways to improve problem of pollution

BIBLIOGRAPHY

Brann, Donald R., Plumbing Repairs Simplified, New York: Easi-Bild Pattern Company, Briarcliff Manor, 1967.

Cosgrove, John J., Principles and Practice of Plumbing, Pittsburgh, Pa.: Standard Sanitary Manufacturing Company, 1959.

Daniels, George E., Home Guide to Plumbing, Heating and Air Conditioning, New York: Harper & Row Publishers, Inc., 1967.

Davis, P. J., Standard Practical Plumbing, New York: McGraw-Hill Book Company, 1960.

Elwell, F. H., Plumbing and House Drain Inspection, Bulletin No. 10, Milwaukee, Wis.: Bureau of Economy and Efficiency, no date.

Haan, Enno R., "Plumbing," New York: Popular Mechanics Home Plumbing Guide, 1957, 2nd Edition.

Johnson, William H. and Newkirk, L. V., Home Mechanics, New York: Macmillan Company, 1947.

Kaiser, M. L., "Repair Kinks for Plumbers," Reprints from Metal Worker, no date.

Kira, Alexander, The Bathroom Criteria for Design, Ithaca, New York: Center for Housing and Environmental Studies, Cornell Univ., 1966.

Maddox, Archibald M., The Polished Earth, New York: Thomas Maddox & Sons Company, 1962.

Manas, Vincent J., Plumbing Laws and Regulations, United States, New York: McGraw-Hill Book Company, 1957.

Manly, Harold P., How-To-Do-It Plumbing Guide, Skokie, Ill.: F. J. Drake & Company, 1954.

Miller, Leslie A., Plumbing and Pipe-Fitting Layout, Job Sheets, Homewood, Ill.: Goodheart-Willcox Company, Inc., 1955, 3rd Ed.

Nielsen, Louis S., Standard Plumbing Engineering Design, New York: McGraw-Hill Book Company, 1963.

Plumbing, New York: Science and Mechanics Publishing Company, A Science and Mechanics Handbook, No. 652, 1963.

Plumbing, United States, Foreign and Domestic Commerce Bureau, Small Business Manual, No. 17 (Establishing of Contracting Business), 1946.

Plumbing: Repairs and Utilities, Washington, D. C.: Government Printing Office (Armed Services Technical Manual TM5-619), 1945.

Pumps and Plumbing for the Farmstead, Washington, D. C.: Commerce Department, Tennessee Valley Authority, 1948.

Woolgar, William J., *Plastics in Plumbing*, London: Hutchinson Technical Education, 1963.

Code References - Current Issues:

American Standards Association, American Public Health Association and American Society of Mechanical Engineers, New York: *American Standard Plumbing Code*.

Plumbing Laws and Regulations, U. S. Public Health Service, Technical Committee on Plumbing Standards (A.S.A. A 40.8-1955), U. S. Department of Health, Education and Welfare, Division of Environmental Engineering and Food Protection (Public Health Service Publication Number 1038), Washington, D. C.

National Plumbing Code Coordinating Committee, a report; Office of the Administrator, Washington, Government Printing Office.

APPENDIX

SOURCES OF FILMS AND FILMSTRIPS

Bureau of Mines, Central Experiment Station, 4800 Forbes Avenue, Pittsburgh, Pa., Attention Mr. Reiners.

A Story of Copper, 16 mm, 33 minutes.

Gray Iron Founders Society, Inc., National City, E. 6th Building, Cleveland, Ohio.

Properties of Gray Iron, filmstrip and record, 17 minutes.

Norwood Films, 926 New Jersey Avenue N. W., Washington, D. C.

The Coppersmith Flaring and Reducing, filmstrip, 43 frames.
The Coppersmith Working Out Branches from a Line, 16 mm, 23 minutes.
The Coppersmith Working Out Branches from a Line, filmstrip, 63 frames.
Cutting and Threading Pipe by Hand, 16 mm, 12 minutes.
Making a Hot Bend, filmstrip, 44 frames.
Reaming with Straight Hand Reamers, 16 mm, 20 minutes.
Reaming with Tapper Hand Reamers, 16 mm, 15 minutes.

University of Illinois, Vocational Agriculture Service, 434 Mumford Hall, Urbana, Ill., Attention Prof. M. Henderson.

Arc Welding Service, filmstrip, 49 frames.
Arc Welding--Equipment and Fundamentals of Welding, filmstrip, 38 frames.
Arc Welding--Welding in Different Positions, filmstrip, 79 frames.
Arc Welding--Learning to Run a Bead, filmstrip, 42 frames.
Assembling and Testing Equipment--Lighting and Turning Off the Blowpipe, filmstrip, 61 frames.

The Jam Handy Organization, 2821 E. Grand Blvd., Detroit, Mich., Attention Richard O. Hammond, Advertising Manager.

Oxyacetylene Cutting, filmstrip, 39 frames.
Reaming, Tapping and Threading, filmstrip, 86 frames.

Modern Talking Picture Service, Inc., 3 E. 54th Street, New York, New York.

Pipe for Progress, 16 mm, 14 minutes.

State University of Iowa, Bureau of Audio-Visual Instruction, Extension Division, Iowa City, Iowa, Attention Lee W. Cochran.

Testing Grease Interceptors, 16 mm, 15 minutes.

PERIODICALS

Master Plumber and Heating Contractor, The Master Plumber, Brooklyn, New York.

National Association of Master Plumbers of United States, New York, New York.